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NOTES AND COMMENTS.

The Importance of Oxygen in Cast Iron.

The reception, from Mr. Young, of an article dealing with the inherent properties of pig-iron, which we print on page 275 of this issue, was extremely gratifying to us, as it gives us hope that the discussion on Mr. Shaw's Paper is not yet finished. Mr. Shaw's contribution was somewhat unique, as it not only struck at the root of what he adequately termed "some perplexing foundry problems," but it has collected under one head the views of many of the leaders of foundry thought throughout the world.

Our correspondence column last week revealed that, to one person's mind, insufficient time was allowed for discussion; but we doubt whether prolonged talking would have produced anything beyond the fact that two schools of thought exist, one lending support to the "inherent property" theory and the other, whilst not denying it, would enunciate an agnostic opinion. Neither can dogmatise until chemical analysis has been improved to such an extent that the quantity, form of existence and co-relation with other elements of oxygen has been definitely determined. If a proposition had been put forward for the Institute to approach the British Cast Iron Research Association to solicit their aid for the solution of this fundamental problem, something concrete might have been accomplished. We are still not without hope that the contributions to Mr. Shaw's Paper will not remain mere ornaments to technical literature, but will become the starting point from which definite knowledge of the utmost utility to the foundry will result. Of the points brought out at the Blackpool meeting, none was more interesting than the fact that electrically-treated cast-iron showed a 23 per cent. improvement in transverse strength over the same untreated material. There are three factors which may contribute to this increase—the higher casting temperature, the distribution of the carbon, and the removal of the gases. This brings us back to the original proposition, as do the majority of interesting foundry problems. *Their solution cannot be satisfactory until the influence of oxygen on cast iron is definitely established in full detail.*

Foundry Apprentices.

At the Liége Congress of Foundrymen, M. Ronceray, of Paris, presented a Paper on "Apprenticeship and Technical Instruction in the Foundry" and outlined some very interesting points, not the least of which is the proposal of the Syndicat Professionnel des Constructeurs Mécaniques et Navales de Nantes et de la Loin Inférieure, to pay to every foundry employer not in a position to engage apprentices the sum of 500 francs (£20 at par) for each apprentice accepted.

Dealing with the number of apprentices which should be attached to any one foundry, M. Ronceray cites the recommendation of the Paris foundry employers' association that each foundry should employ seven apprentices per hundred workpeople, skilled or unskilled. This figure was decided upon as it was thought that only 4 or 5 per cent. will complete their time. Where, however, sections of the trade employ an abnormal quantity of skilled men, the first figure should be increased to 10 per cent. of the number of skilled men employed and 3 per cent. of the labourers, these figures being subject to modification, when the statistics now in course of preparation are completed.

As previously pointed out in this column, the French generally are in favour of a pre-apprenticeship course, and again it is emphasised that the average French child shows a marked preference to become a mechanic or an electrician. Such conditions scarcely obtain here, and we are of opinion that the average boy would be fascinated by the glare of the furnaces and choose a melting department as his trade.

As the result of an inquiry, the French foundry employers' association are of opinion that apprenticeship carried out in the foundry produces superior workmen to those trained in special schools, but to be profitable, their instruction must be methodical. Until suitable organisations have been formed, it is recommended that sections of apprentices be organised under the direction of a skilled workman, specially chosen for his aptitude and character, and not to mix apprentices with the rest of the workmen until the end of the second or even the third year. Apprenticeship schools only appeal to the employers' association when it is found impossible to find room for them in the foundry. Then reason for this general opinion is that the foundry atmosphere, up-to-date machinery, and the meeting with real industrial conditions are alone capable of producing first-class workmen.

XUM

If apprenticeship schools are found to be indispensable, then they should be supplemented by a long period in the foundry.

The French apparently are of opinion that three years' apprenticeship is sufficient, and on completion the journeyman should be attached to foundries other than that in which he was trained.

This problem is to be further discussed at the second Congress on apprenticeship, to be held at Lyons on October 12, and presided over by the Under-Secretary of State for Technical Instruction.

It is to be hoped that the foundry industry of this country will shortly awaken to the importance of the problem of finding recruits.

Co-operation.

International co-operation is only possible when the conditions are clearly mutually beneficial, and as such is capable of unlimited expansion. It is to the credit of the foundry industries of Great Britain and America that their premier technical associations have decided upon a system of co-operation, which has commenced by the installation of an exchange of Papers for presentation at each other's annual conferences.

The Blackpool conference saw the inauguration of the scheme. The Paper presented by Mr. George K. Elliott was enthusiastically received, as it opened up avenues for thought as yet scarcely explored by the average British foundryman. At the next conference of the American Foundrymen's Association, Mr. F. J. Cook, of Birmingham, will contribute a Paper, which is certain to be of equal outstanding technical interest

Progress in technical matters is based on knowledge, of which no nation will ever possess a monopoly. Thus, no other result can ever come about but the mutual benefit of the two participating countries.

It is a matter for congratulation that foundrymen who, until recently were reticent in the matter of exchanging information, should be the first to recognise that its international extension would be beneficial.

We can only hope that ways and means of the extension of this co-operation will be brought about, in order that other sections of the community will follow the lead of the foundry, for it is on the appreciation of each other's difficulties that international goodwill is based.

The Cleveland Technical Institute, Middlesbrough.

This Institute has for its objects the further education of the technical and workmen staffs in the local works, and the advancement of mining, metallurgy, engineering and shipbuilding on the Tees-side by the provision of suitable buildings in which technical deliberations can take place and a library be housed.

Suitable premises, situated at Corporation Road, have been acquired. It contains two lecture halls, library, lounge and various smaller rooms.

Though primarily Dr. Stead is responsible for the inception of the scheme, the carrying out of the work has been in the hands of a joint council of the Cleveland Institution of Engineers and the North-East Coast Institution of Engineers and Shipbuilders.

The opening cermony took place on September 22 by Sir Charles A. Parsons, K.C.B., F.R.S., the chair being taken by Sir Hugh Bell, C.B., D.L., Bt.

Dr. Stead, D.Met., F.R.S., is the first chairman, Mr. J. H. Harrison, M.I.C.E., is deputy-chairman, and Lt.-Col. Edward L. Johnson, LèsSc., F.G.S., is director and secretary.

Industrial Welfare Society.—Mr. Arthur F. Agar, late chief organising inspector of munitions canteens, was the principal speaker at a recent conference on canteen organisation, promoted by the Industrial Welfare Society. Before the war, he said, when there were probably not more than a hundred canteens in existence, employers were reluctant to provide them for their workpeople, and it was with difficulty that they could be brought to see the necessity for them. The industrial canteen movement was brought into being by the Government in connection with the manufacture of munitions. After the war it was expected the movement would drop off, but it had held on, and even now, in spite of the serious trade depression, was making headway.

Metallurgical Conditions in the Serb-Croat-Slovene Kingdom.

Captain E. Murray Harvey, O.B.E., M.C., the Commercial Secretary of H.M. Legation, Belgrade, states that the furnaces in Bosnia (Vares and Lenica), which are the property of the State, have not been able to work at anything like full pressure, owing to strikes and the lack of coal. In Slovenia, the works at Jesenica have also had troubles. The engineering workshops, however, have had a good year, as they were concerned with the repair of factories and plant which had been damaged during the war.

In Serbia, where it has not been possible to reconstitute the large works which have been damaged, some small foundries and engineering works have been established. This branch of industry could be greatly expanded; railway and other construction require great quantities of material, such as rails, wagons, locomotives, etc., and agricultural implements are also in great demand, which it is thought could well be manufactured in the country, as raw material exists in the form of large deposits of iron ore.

Iron and Steel and Cast Iron in Czecho-Slovakia.

Mr. R. H. Bruce Lockwood, the Commercial Secretary to H.M. Legation at Prague, reports that during the past two years lack of fuel and transport difficulties have been a millstone around the neck of the Czecho-Slovak iron and steel industry. Even when the demand for iron and steel, both for home and export markets, was at its height, irregular and insufficient deliveries of coal prevented factories from working to the full extent of their capacity. The shortage of coal has now happily been overcome, but the industry is now faced with the problem of adjusting its prices to those ruling in the Western countries. Dear fuel, high freights and high wages—and perhaps the desire for abnormally high profits—are making it increasingly difficult for Czecho-Slovakia to compete in the world's markets, even in those countries which must be regarded as her natural economic neighbours. Her greatest competitor is Germany. The following Czech and German prices are interesting for purpose of comparison:—

	C.-S. K.	Germany. Mk.
Cast iron, per 200 kg. ...	225	156
Rolled iron, per 200 kg. ...	375	200
Rough tinplates, per 200 kg.	450	225

From the above figures it will be seen that the difference in price between cast iron and rolled iron amounts to only Mk. 44 in Germany against K. 150 in Czecho-Slovakia. This means that the process of rolling costs about K. 98 per 200 kg. more in Czecho-Slovakia than in Germany.

No official statistics on the working conditions and output of the various works in the iron and steel industry are available, and private statistics are very unreliable on account of the unsettled conditions. Steps, however, are now being taken to prepare official statistics of this industry for the year 1922.

The late Mr. G. F. Fitton, of Grove Lodge, Headingley, Leeds, iron merchant, left £29,735.

The late Mr. William Jones, of Edgbaston, Birmingham, retired brassfounder, left £17,531.

The late Mr. T. B. Lightfoot, a director of Bell's United Asbestos Company, Limited, left £50,723.

Mr. R. H. Willis, who died at his home in Manchester on September 17, was for some years with Mather & Platt, Limited; afterwards he became manager of the British Electric Plant Company, Limited, and subsequently he joined the staff of Crompton & Company, Limited, as engineer and manager of their Manchester branch. He had been connected with the Association of Mining Electrical Engineers since its earliest days, and had taken an active interest in its welfare, latterly becoming chairman of the Publications Committee of the Association.

XUM

Moulding Slag Ladles.

By E. Longden.

Normally an average of about 1½ tons of slag is formed in the blast furnace during the reduction of 1 ton of iron. Various methods have been adopted to convey the slag to the dump heaps, but the most effective and modern way is to carry it in cast-iron ladles similar to the pattern shown in Fig. 1. The capacity of the ladle about equals its weight, and the weight of the ladle sometimes exceeds 20 tons, but the one here dealt with is 10 tons.

Some founders make the castings in dry sand from a full pattern, but the most economical and

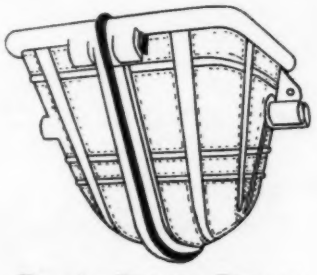

Fig. 1.—Ordinary Type of Slag Ladle.

soundest castings are produced in loam, using only a skeleton of the pattern. The dotted lines in Fig. 1 indicate how much of the pattern is needed when moulding in loam. The skeleton pattern must be strongly constructed and will embrace the whole of the top rim, flanges used for bolting the halves together and holding the prints for splitting cores, ribs, snugs, trunnions, and a proportion of the walls as a guide for strickles.

Fig. 2 is a plan and elevation of top plate showing distribution of runner gates, riser gates, vent holes and bolts which secure the plates used in the construction of the inside of the mould. The plate is 3½ in. thick, freely perforated with holes. Section AA and BB show the method of handling the top part of mould. Loose shakels, bolted into the handles, are used as shown. Dotted lines give a plan view of the casting.

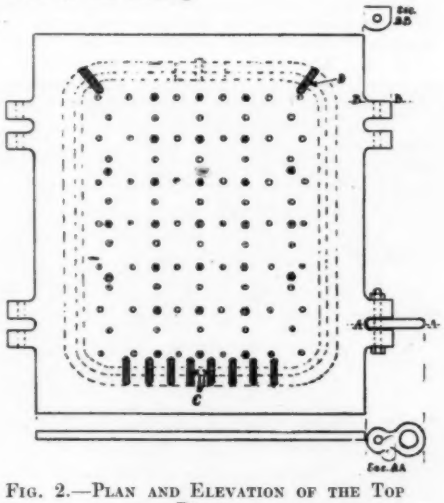

Fig. 2.—Plan and Elevation of the Top Plate.

Fig. 3 is a half section of the mould when closed, and gives another view of the top plate to which is attached the bars which carry the inside or core of the mould.

Fig. 4 shows the elevation and side view of the centre plate, with wrought-iron bars cast in to support the brickwork; the others are similar, all conforming to the shape of the casting. These plates are soundly bolted to the top plate. The casing is about 1¼ in. thick and follows the shape of the casting as far as possible. Boxes are fastened to the sides to take the trunnions.

To commence moulding, the top plate, with the bars attached, is set on the floor. The bricks, which must be strong, are set in new loam and wedged between the upright plates; the wrought-iron bars, which run horizontally, complete the security of the structure. Care in setting the brickwork is done with a view to the repeated use of the building. Although in ordinary loam practice only about ¾ in. of loam is placed on the surface of the bricks, in this method 1½ in. is allowed. The core, or inside of the casting, is perfectly plain; it is therefore unnecessary to fix

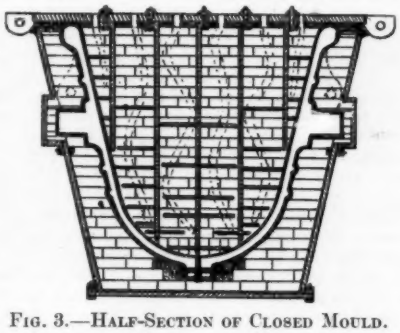

Fig. 3.—Half-Section of Closed Mould.

on loose pieces until the pattern is required for the bottom side of the mould. This loam is first rubbed on the brickwork, then sufficient stiff loam to bed-on the skeleton pattern. With the pattern bedded in position loam is worked behind the skeleton through the openings, finally a thickness of loam is laid in the openings and strickled to shape. Very stiff loam is used to form the joint which stands up about 3 in. from the plate. The brickwork soon absorbs the moisture and sets the

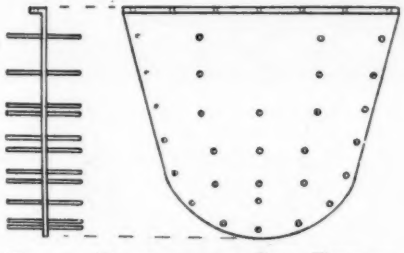

Fig. 4.—Elevation and Side View of Centre-Plate.

loam much more quickly than the material forming the joint, hence the reason for using very stiff loam when placed immediately on iron. A simple strickle, similar to the one shown at A, Fig. 5, is used to form the joint. To locate the top with the bottom, flats are cut in several places on the sides of the joint, using a gauge as shown at B, Fig. 5. The gauge is used when the mould has been finished. The dressing of the mould is proceeded with immediately the pattern is drawn, be-

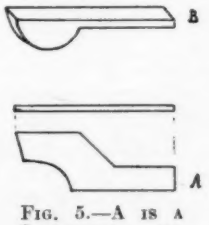

Fig. 5.—A is a Strickle for Forming the Joint, and B the Gauge for Locating the Top with the Bottom.

cause the loam is still plastic and is easily finished to the correct shape with wooden tools. The insides of slag ladles must be perfect, any flaws would interfere with the ejection of the slag skull when the ladle is tipped. After stoving, the top is twice blackened with best plumbago. Quite a polished finish is effected.

The bottom side of the mould is more difficult to produce, due to ribs, snugs and trunnions, etc.

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As with the top, bricks are set in new loam to allow of the repeated use of the main structure. Only the brickwork above the trunnions is destroyed when extracting the casting. Loam is again laid to bed on the pattern and loam worked through the openings as before described. A prodded plate and grid is used to carry the material above the trunnions. A thickness of loam is placed in the openings of the pattern and strickled to shape. The joint is made and formed very much the same as with the top side of mould, using a strickle, and later, when mould is finished, a gauge is used to cut flats on the sides of the joint to correspond with similar ones made on the top. Screws are taken out of all loose pieces of pattern which will not lift freely from the mould and the pattern drawn from the casing. All operations are obviously quickly done, except finishing the bottom side of the mould. Here again, as in the top, but mainly for the artistic effect, the mould is well finished. This part of the mould is not dried outright, previous to blacking with plumbago. An open fire is hung in the mould overnight. Next day the mould is cleaned and finally blackened and stoved. The dressing of the bottom side of the mould is obviously laborious. To finish the lowest part of the mould, the operative is suspended from a sling hung above the mould.

When both parts of the mould are dry and whilst the bottom side is still warm, the splitting cores, shown in Fig. 6, and which cut the ladle in halves, are put into position. Round cores, which form

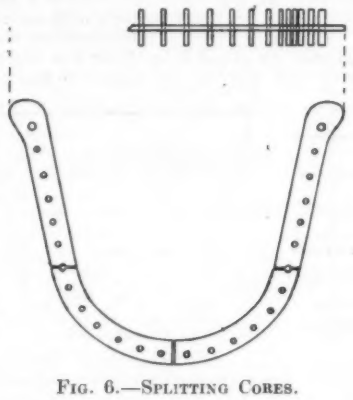

FIG. 6.—SPLITTING CORES.

the holes for bolting the two pieces of ladle together, are threaded through print holes in the splitting cores. When the prints above the round cores are made up the splitting cores are firmly secured.

When closing the mould, in addition to the flats and marks on the joint, the thickness is ascertained and checked by clay impressions of the walls of the mould. It is very necessary that the walls of the ladle should not vary other than as designed. Any error in section reduces the life of the ladle due to lack of uniformity in expansion and contraction.

The casting is run by way of top drop gates. At C, Fig. 2, will be seen the runners and at D the riser gates. The runner gates, eight in number, 1¼ in. dia., are slanted to follow the mould cavity as nearly as possible. Loam runner basins are used. This method of running, with metal not too hot, has been found to give excellent results.

When the casting is quite set the bolts and cramps are loosened and the top lifted about 1 in. This is done to prevent the casting seizing the brickwork and plates in the top side of mould.

Slag ladles are cast with 100 per cent. unadulterated No. 3 hematite pig-iron. The splitting and bolt-hole cores must be made from very refractory material. A mixture which has proved very satisfactory is made up from 25 per cent. ganister, 50 per cent. plumbago, and 25 per cent. red sand.

The Stanton Iron Works have taken up an invention which enables them to produce cast-iron pipes considerably cheaper than their competitors. The company have tendered for 8-in. cast-iron pipes for the Alfreton Waterworks at £13 the ton, which is considerably below quotations by other foundries.

Hot-Strip Coiling Machine.

Our illustration (Fig. 1) shows a strip-coiling machine built by Mr. W. Badger, Cupola Works, Rotherham, as recently installed at the Great Bridge Works of the Improved Steel Company, Limited, and into the design of which new features have been introduced.

The machine is arranged for belt driving through a friction plate mounted on a secondary shaft upon which is also keyed a spur pinion which meshes with a spur wheel on the main coiling shaft. The end of the secondary shaft is provided with a double-thrust ball bearing which takes up the thrust either way when the main shaft is put into the relative position for coiling or uncoiling, whilst

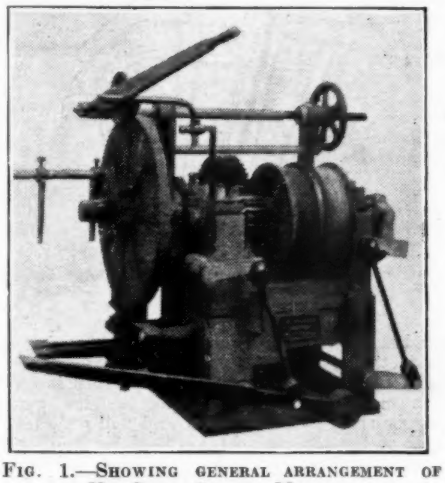

FIG. 1.—SHOWING GENERAL ARRANGEMENT OF HOT-STRIP COILING MACHINE.

when the main shaft is in motion the thrust is taken up by two ball races mounted on a sleeve between the bearings and driving pulleys at either end of the shaft. Adjustment for various widths of strip is made through a handwheel which operates on the tension wheel lever. The large plate which carries the push-off plate is made with a broad brim at its outer circumference to provide for a braking tread.

The braking mechanism calls for a little explanation, and this will be the more easily understood when read in conjunction with our line illustration (Fig. 2). The brake is composed of a lever A mounted on a fulcrum pin in a bracket on one end of the machine, the lever being provided with

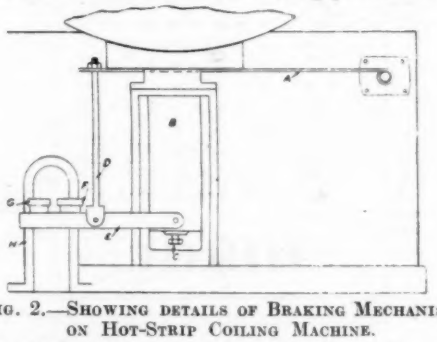

FIG. 2.—SHOWING DETAILS OF BRAKING MECHANISM ON HOT-STRIP COILING MACHINE.

a hardwood block on its working face. The circular box B contains a compression spring with a taking-up compression screw C, while a recess on the top of the box houses the flat of the lever A so as to ensure the same always registering centrally. Provision is made for adjusting the tension of the brake through the lever rod D. A forked lever E is mounted on two fulcrum pins at the bottom of the spring box and extends under the levers F G for registering same when the brake automatically comes into action after either of the levers referred to has been put into operation, according as the machine is to be used for coiling or uncoiling. The bracket H, fitted at floor level, is so arranged that when either of the operating levers is depressed, the position is fixed until released by a slight movement of the foot, when the brake immediately comes into action and registers the levers.

The Foundry at Broad Oaks Ironworks.

The Foundry of Messrs. Markham & Company, Limited, Broad Oaks Ironworks, Chesterfield, is an excellent example of a modern lay-out in which expedition and economy have been made second only to the quality of the productions. To meet the demands of the engineering shops the castings naturally cover a very wide range, varying in weights from a few ounces up to 40 tons, whilst a recent addition to the plant enables the foundry to turn out steel castings up to 50 cwts. in weight.

The stocking ground extends for the full length along one side of the foundry, and is served by sidings directly connected up with the railway, thus, when desired, the furnace hoists, coke bunkers and sand mills can be fed direct from the wagons bringing in the material.

There are two cupolas with melting capacities of 5 tons and 6 tons per hour respectively; these are served by an electric hoist, and blast is supplied by a No. 8 Sturtevant fan which is belt-driven from a motor, the fan itself being carried on a concrete pillar immediately at the side of the larger cupola.

The foundry is covered by two main bays, each 400 ft. long by 45 ft. and 37 ft. wide, for the heavy and light casting bays respectively.

Fig. 1.—Broad Oaks Ironworks.—The Iron Foundry.

The sand shop adjoining the heavy bay contains the usual pan mixer and also a special mixer for oil sand. The whole of the cores are now made in oil sand; this has been found to not only give cleaner castings, but has led to increased production, and at the same time placed much of the work within the scope of unskilled labour.

The heavy bay is served by three 30-ton overhead electric cranes, and in addition there are five hydraulic jib cranes, each of 50 cwts.

At one end of the bay is a wheel and cylinder pit 24 ft. in diameter, the bottom of pit is formed with a T-slotted plate, so as to facilitate the bolting down of all sizes; a second pit is provided for large castings, 18 ft. in diameter by 20 ft. deep. To facilitate the setting up of bed

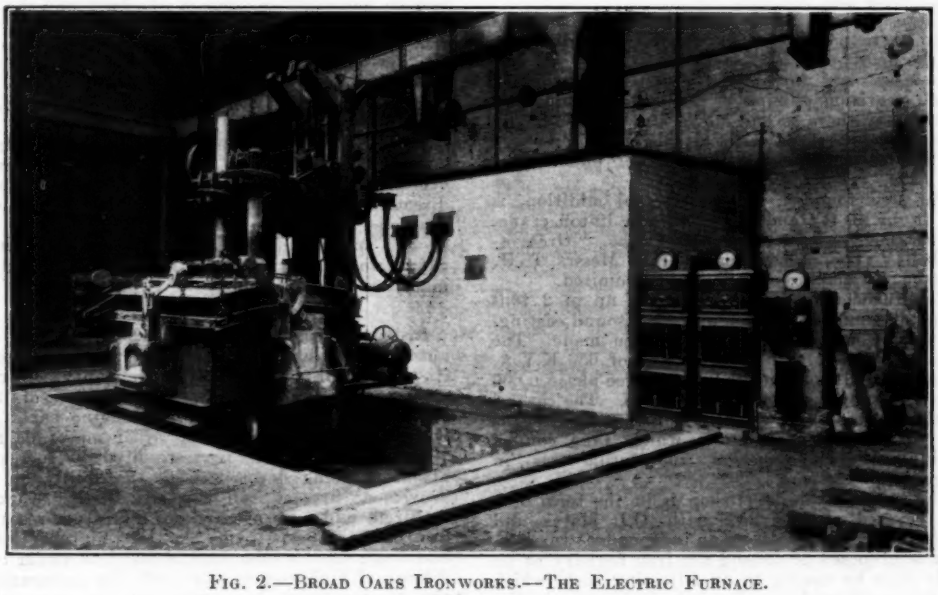

Fig. 2.—Broad Oaks Ironworks.—The Electric Furnace.

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plates there is a pit 80 ft. by 16 ft. by 8 ft. deep; the sides of this pit are formed of heavy cast-iron plates, which extend down to and are bedded in the concrete floor, and in addition there are four cylinder striking pits.

The stoves are arranged in three groups, the first comprising one stove 25 ft. by 20 ft. by 12 ft., and two stoves each 20 ft. by 12 ft. by 12 ft., the No. 2 group, three core stoves, one 16 ft. by 16 ft. by 10 ft., and two 10 ft. by 16 ft. by 10 ft. These two groups are heated by hot air, the blast fan being common to both; the blast is heated by passing through independent furnaces, which are fired with a mixture of fine slack and coke ballast.

The third group of stoves, which is fired by an independent furnace and forced draft supplied by a 10-h.p. fan, consists of two stoves 20 ft. by 25 ft. by 12 ft. and 20 ft. by 12 ft. by 12 ft. respectively.

A casting pit is provided in front of the cupolas, and this is travelled by a bogie provided with a hydraulic ram head. The bogie is designed to carry a 30-cwt. ladle and the ram to raise this to floor level, where it is travelled along bogie tracks to the point required; this provision saves holding up the shop cranes when only light castings are being made.

In an annexe a small shop is laid off for light core making, and here a Wadsworth machine is installed which can produce cores from ½ in. up to 3 ins. diameter. The core stove is coke fired. There is also a separate bolt shop; the moulders are not called upon to do the bolting down, as a special man devotes the whole of his time to this duty.

The crane runways in the light bay carry three 10-ton cranes, but the floor is also served by hydraulic jib-cranes, which are mounted on the centre columns between the bays.

The machines comprise a jolt ram with 20-in. cylinders, operating a 6 ft. 6 in. table, equal to a lift of 8 tons, with an air pressure of 90 lbs.; three jolt rams with 6-in. cylinders, and a portable jolt ram which travels between parallel lines of tables; normally, the base of this machine rests solid on the floor, but when it is to be travelled the weight of the table is taken by two 3-in. rams; the jolt is operated by a 6-in. cylinder.

An unusual and interesting feature of the equipment is the shake-out table for shaking the sand out of the moulding boxes. The table, 10 ft. by 6 ft., is mounted at one end upon the heads of two cylinders, which raise it on a fulcrum at the other. Boxes up to 6 tons in weight can be readily handled and the table is remarkably expeditious and efficient.

There is also a Buckley & Taylor wheel machine up to 10 ft. in diameter, or up to 14 ft. in diameter on the floor.

Two beds are furnished for casting core irons, which provision eliminates the usual levelling up. In this bay there is one stove, 10 ft. by 18 ft. by 9 ft., which is fired with air blast.

The fettling is done in the lower ends of the two bays.

The steel foundry, the most recent addition, is 130 ft. by 40 ft., and is served by a 10-ton crane.

The melting furnace is of the "Greaves-Etchells" type, and was supplied by Messrs. T. H. Watson & Company (of Sheffield), Limited.

The furnace is designed to take up to 2 tons of metal, and as a matter of fact a sound casting, 2½ tons in weight, has actually been made. The furnace is fitted with transformers of 650 K.V.A. capacity, and is connected to a three-phase 6,600 volt A.C. supply system of 50 periods. The control of the electrodes is entirely automatic by means of "Watford" regulators, which take control during the whole period the furnace is in operation.

The stove in the steel shop is in the form of a pit covered at floor level with C.I. plates and heated with hot blast from an independent furnace.

It is proposed to extend the iron foundry at an early date by taking in an adjoining shop, which is at present used to relieve the congestion in the engineering erecting shop.

The pattern shop, 90 ft. by 45 ft., contains a Wadkins pattern-making machine, Oliver mitre cutter, two circular saws, band saw, planing, sanding, tool sharpening machine, etc. There is a small brass foundry, where a Morgan 400-lb. furnace, a two-pot (80 lbs.) crucible furnace, and a jolt ramming machine are in service.

Cast Iron for Automobile Engine Castings—Part 3.

Continued from Page 214.

Permanent Moulds and Die Casting.

In addition to the uniformity of chemical composition and properties, one of the main requirements of cast-iron castings for automobile engine purposes is uniformity of size, shape and dimensions. This lack of uniformity of dimensions is probably the most frequent source of waster castings, and very often a variation in the dimensions of a casting in an otherwise unimportant part is sufficient to reject the casting which is required to be machined by some special jig method. With a view to eliminating the various sources of errors in this connection, such as pattern drawing, surface finish, adjustment of cores and the like, ironfounders have cast their thoughts towards permanent moulds or dies. The advantages to be gained by the use of some form of permanent metal mould in so far as it bears on the defects liable to arise in the course of sand moulding does not need further elaboration.

The use of dies or permanent moulds in the production of castings in cast iron is not by any means of universal application, and is fraught with several difficulties not encountered in the die-casting of non-ferrous metals. The chief of these difficulties are the higher temperatures involved and the difficulty of thoroughly eliminating chill. As regards the former this is not so serious when using stationary chill moulds in exactly the same manner as sand moulds. It does, however, more or less bar the way to the use of pressure die-casting machines on the lines used in non-ferrous work. The second difficulty is probably the most important and acts as a serious restriction to the development of die-casting methods in cast iron.

The development of die-casting also depends upon assistance from the designing and engineering side of automobile production. More extensive standardisation of parts and the simplification of the shapes and forms of castings are necessary to enable the heavier initial mould costs to be spread over a greater number of castings.

Intimately connected with die-casting, the process of centrifugal casting in cast iron is likely to exert considerable influence on the improvement of cast iron for automobile purposes. This process is at present being applied to the production of articles having a cylindrical internal form, such as cylinder liners, piston ring sleeves, gear wheel blanks, and other castings of like form and shape.

Apart from any advantages relating to shape and size the use of metal permanent moulds by virtue of the increased rapidity of cooling thereby attained results in valuable improvements in the mechanical properties. The effect, of course, is now well known.

The use of permanent moulds made from materials other than metal is not extensively practised. Many attempts have been made in this direction, and the patent journals contain many examples of these. Dr. Moldenke recently expressed his personal opinion that the permanent mould would be preferably made from refractory materials rather than metals.

Future Research.

In spite of the extended use of cast iron in the automobile industry in the past, our knowledge of its physical properties is still very scanty. During recent years the almost universal use of this material for many of the vital engine parts has been seriously challenged by other materials and alloys. This has in part resulted in increased attention being devoted to the possibility of improvement in cast iron, but still further work is required, and some of the lines for future research are indicated below:—(1) The elastic properties of cast iron; (2) the behaviour of cast iron under conditions of high temperature; (3) the influence of the temperature of pouring on the properties, particularly temperature ranges above those ordinarily used at the present time; (4) the influence of certain additional elements, particularly such elements as copper, chromium, and nickel, on the properties of cast iron.

These and other lines of investigation call for immediate attention, and are likely to prove of value in the future development of the industry.

XUM

Inherent Properties of Pig-Iron.

By H. J. Young, F.I.C.

According to the supporters of the theory that pig-iron possesses inherent properties, it would seem that the term "inherent," as used in this connection, implies not only something inseparable and going on and on, but also that that something is unexplained by the composition of the pig-iron, and persists in spite of the fact that pig-iron varies in composition from consignment to consignment and often throughout any one consignment.

Whether differences in cupola practice or different methods of melting in crucibles, or electric or reverberatory furnaces, leave these properties unaffected, in spite of the fact that each method and each variation of each method has its own effects upon the composition, is not made clear.

That the above is a correct description and enunciation of the "inherence theory" would appear to be correct in that one of its exponents expressed his belief that pig iron was like a child inheriting inherent properties from its parents and passing them on through countless generations. This same gentleman proceeded to say that all human beings, although vastly different one from another, had the same composition. Although that is utterly untrue, and although the ultimate analysis of the population would probably reveal no two exactly similar analyses, it is evident, from this gentleman's analogy, as to what we shall understand to be the "inherent properties" of pig-iron.

Another adherent of the theory said that he had "stabilised" his cupolas and his making of test-bars, and could only account for the differences in the tests by some "inherence" theory.

At this point it would be well for every foundryman to ponder over the statement that the cupolas were "stabilised." There is a word called *empiricism* which, in plain language, means dependence upon mere observation and experience to the exclusion of scientific knowledge or knowledge of the relation between cause and effect in any particular case. Foundry work generally has been built upon empiricisms of this nature, and to them we owe many fictions, such as those dealing with sulphur, phosphorus, etc., in cast-iron, and also those relating to the wonderful properties ascribed by various foundrymen to various brands of pig-iron.

Let us examine, for instance, this particular claim that "the cupolas were stabilised." The air in the air-belt possesses a certain amount of super-pressure, but the air, after leaving the tuyeres, passes into the interior of the furnace, and therefore this super-pressure must necessarily disappear and all that is left is a certain *volume* of air. Therefore, as the pressure of the air in the air-belt alters, or is altered, so does the *volume* of the air in the cupola alter. Summing up the situation, it comes down to the probability that once the air is inside the cupola there remains nothing to consider but the question of its *volume*. Further, we know that the pressure in the air-belt fluctuates throughout the blow, and hence it follows that the *volume* of air within the cupola must also be fluctuating.

Only by knowing and controlling the *volume* of air entering the cupola can we *stabilise* the cupola practice and, here comes the important point, there is yet to be invented or perfected the instrument that will measure correctly air passing at the slow speed of the cupola blast.

Therefore, the worker claiming "stabilised" cupola working is either relying upon empiricism or withholding knowledge unknown to the scientific world.

The foundryman frequently, almost constantly, expresses astonishment that two apparently-similar test-bars do not give the same results—a fact we all know to be true, no matter whether the test-bars are cast from the same or different pig-iron. A little thought will convince us that to make two things alike is one of the most difficult undertakings in the world—nature herself rarely succeeds in doing it. A dozen different and delicate tests applied to two apparently-similar objects will usually be more than sufficient to prove that in one way or another those two things are not precisely alike. Hence, it is no matter for amazement that two objects made in cast-iron are difficult to manipulate in order to obtain similar tests from each of them.

Cast-iron is a subject of which we know the merest fringe. It is a metal containing fifteen to twenty elements, how many we do not know, nor do we know which of them are important to the needs of modern engineering castings. These elements exist in the metal in all sorts and conditions of combination, freedom, solution and dissolution, stability and unstability. Segregation alone is an enormous factor to reckon with, while slag in the metal may be a greater factor still. In steel, for example, the effects of slag are known to be very vital and are only partly understood.

The subject may be closed by pointing out that the average foundry has little time or money to spend upon such big investigation as that of the inherent properties of pig-iron. The foreman or manager has to purchase those irons which best suit his purpose. When in trouble he is at the mercy of inflated advertisements of pig-iron and other remedies for his troubles, and in every case the remedy is an expensive one, and in many cases it is fallacious and equally good results could be got by other and cheaper means. One expensive remedy contains as much as 1½ per cent. of phosphorous, yet it is universally used and the fluidity got from the high phosphorous is attributed to the marvellous properties of the material in question—as a matter of fact the same mixture obtained by the use of common cheap high-phosphorus irons gives the same result.

The foundry industry is aching for a solution to these problems. It needs good honest pig-irons of known composition and known properties, and sold on the value-for-money principle. Probably, no better work could be undertaken by the British Cast-Iron Research Association than that work which would put every foundry in possession of the true facts about every brand of iron, and it will at once be senn that nobody save the quacks has anything to fear—a good article always commands a good market, particularly when the light of knowledge is shed upon it.

We do not know whether pig-irons have inherent properties as above described, and it is high time we did.

Canadian Iron and Steel Output (1921).

According to the June report of the Dominion Bureau of Statistics at Ottawa, the advance in the Canadian output of pig-iron and ferro-alloys noted in May was fairly well maintained, although pig-iron production declined slightly from 56,091 long (2,240-lb.) tons to 54,812 tons. On the other hand, the amount of basic iron made rose from 44,002 to 48,870 long tons, all of which was used by the makers. The output of foundry iron made for sale also dropped slightly from 4,709 tons in May to 4,389 tons in June, and foundry iron produced by makers for their own use showed a considerable decrease, from 5,206 tons in May to only 825 tons in June. Six furnaces were in blast at the end of June, one additional furnace having been blown in during the month by the Dominion Iron & Steel Company at Sydney, N.S. At the close of the month three furnaces were in blast at Sault Ste. Marie, one at Hamilton, and two at Sydney.

During the six months ended June 30, 309,206 long tons of pig-iron were made in Canada, as compared with a total of 449,810 long tons during the corresponding period of 1920. An analysis of the output shows that 71 per cent. of the total was basic, 21 per cent. foundry, and 8 per cent. malleable iron. The production of ferro-alloys, including several grades of ferro-silicon, and also spiegeleisen, amounted to 10,781 tons during the same half-year.

The output of steel ingots and castings in Canada during June was the highest during the present calendar year, rising to 64,103 long tons, as against 52,001 tons for May. The total production during the six months amounted to 295,140 long tons, electric steel production accounting for 10,938 tons, 282,648 tons being produced by the basic open-hearth process.

XUM

Economising on Special Jobs.

By F. C. Edwards.

It frequently happens that an alteration—simple, perhaps, in itself—is required to be made to a pattern that is in regular use in the foundry. The alteration, if carried out on what may be termed orthodox lines, would necessitate new

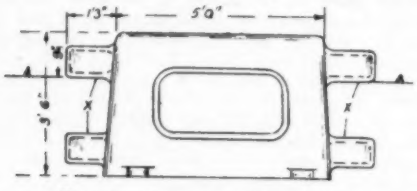

Fig. 1.—Section of Base Box.

tackle, box parts, etc., involving heavy expense. In such cases the exercise of a little ingenuity will generally lead to the adoption of an expedient which, though not suitable for regular production, is quite permissible for a special job. These ex-

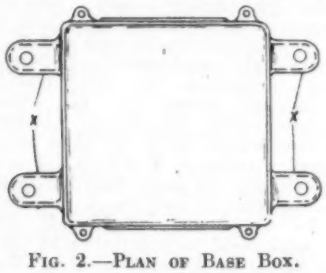

Fig. 2.—Plan of Base Box.

pedients, of course, vary with requirements. An example of one kind is shown in the base box, Figs. 1 and 2, with which the writer recently dealt.

In Fig. 1 extensions "X" were required on a standard pattern. The moulding boxes available would not permit of a joint being made at A A

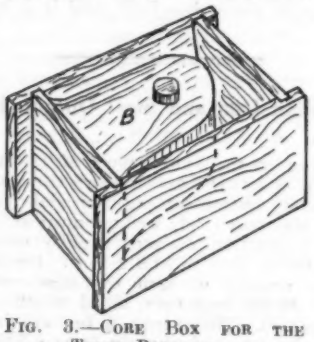

Fig. 3.—Core Box for the Thick Portion.

(the job was moulded, of course, in an inverse manner to that shown in elevation) to allow of the withdrawal of the projections and the insertion of the lightening cores, and it was decided to proceed as follows:—A core box, shown in Fig. 3, was made to include the major portion B of the exten-

Fig. 4.—Core Box for the Thin Portion.

sion piece, and another core box, shown in Fig. 4, contained the thin portion C.

Obviously a core box was required for the centre lightening core D, Fig. 5, which shows, in section, the three cores assembled, and is self-explanatory.

In moulding the job these blocks were placed with their open faces against the sides of the pattern—shown at E, in Fig. 5—upon which their positions were plainly indicated. The ramming up of the pattern was proceeded with, and the cores (containing the extensions), forming part and parcel of the mould, required no further attention after the pattern was withdrawn.

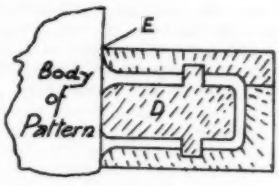

Fig. 5.—Core Box for Lightening Core.

It will be seen that this method is economical, both in the pattern shop and the foundry In the above example material and labour were saved in the pattern shop, since the two core boxes containing the sections of one extension piece replaced the eight complete extensions required by ordinary practice. In the foundry the saving of a new moulding box was effected, and the plain block cores simplified moulding to an extent which more than offset the cost of core-making. With slight variations the method may be adapted to a very wide range of work.

The Casting of Brass Ingots.

By R. Genders.

The failure of hollow-drawn articles, made from 70/30 brass rod, by splitting on expansion during manufacture or in service, has generally been found to be due to the presence of non-metallic inclusions in the cast ingot. In articles drawn from cupped discs, punched from rolled strip, the inclusions in the walls are circumferential in direction and of less effect on the wall strength. The methods used in casting brass ingots vary considerably in detail. Much consideration is given to the saving of rolling, and ingots are made in a correspondingly suitable form, those used for the making of rod commonly being long and narrow. Such forms are not particularly undesirable when the finished product is solid, but where a hollow article, subject to expanding stresses in use, is to be made, the avoidance of inclusions of foreign matter is vital, and the form of ingot requires considerable modification.

In experiments which were carried out to minimise the occurrence of non-metallic inclusions a form of ingot was adopted whose length was not great in proportion to the cross sectional area. The ingots made were 3 in. sq. and 30 in. long, as compared with the ingots 6 to 7 ft. in length and 1½ in. sq. section in common use. Steel-making practice was followed in introducing a hot sinking head or "dozzle." The molten brass is poured through the dozzle, which is filled to the top. No pipe is formed in the ingot proper, and additions of metal may be made at any time to the metal in the dozzle without risk of introducing defects into the ingot, any dross rising to the top of the still fluid head.

The moulds were tapered, the top being enlarged by increasing amounts in successive experiments, and ingots were cast at the usual foundry speed. It was found that with a mould 3½ in. sq. at the top, tapering to 3 in. at the bottom, no shrinkage cavities were formed, and the ingot appeared to be practically sound. By these methods failures which previously reached large percentages were reduced to practically nil.

The partnership between Messrs. J. Parks and T. Faulkner, The Cranage Works, Manchester Road, Northwich, trading in the style of Parks and Faulkner, boilermakers, machine tool dealers, and general ironworkers, has been dissolved. Mr. T. Faulkner continues the business.

* Paper read before the Institute of Metals.

Brass Casting.*

By Frank A. Livermore, F.C.S., M.I.Met.E.

There is no problem in metallo-technology which appears on the face so simple and which is in reality often so difficult as the production of sound castings. It takes an experienced person, and one well acquainted with the tricks of the trade, to assist him in dealing with the subject, and this may serve as a reason for entering at some length into a somewhat threadbare topic.

The demand for ever-increasing efficiency in the brass foundry has led to considerable improvements in the technology of the metal and component metals. Perhaps the most important item is that of metal control, which is probably the predominant factor in the successful working of the foundry. The most difficult problem is the melting of the metal, and as this end of the foundry is equally, if not more, important than any other, it is essential that the trouble be reduced to a minimum both for the benefit of the product of the foundry and for the physical well-being of the man in charge.

Most brass foundries use crucibles for melting; the use and proper care of which play an important part in the successful running of the foundry. The crucibles are stored in a warm place—at the back of the furnace—to prevent them from absorbing moisture, which causes the sides of the crucible to flake and scale, due to the expansion and partial disintegration of the crucible constituents. Immediately prior to use the crucible should be well annealed; this is done by setting the crucible on the top of the furnace for about 48 hours and then introducing it into the furnace and gradually raising the temperature to about 400 deg. C.; this ensures freedom from subsequent crucible cracking and brings it to a state of maximum efficiency. All tongs and foundry furnace media used for lifting out the pot should be made a perfect fit; inaccurate shape causes distortion of the pot when it is white hot, and with distortion follows a considerable decrease in the life, strength, and durability of the pot.

The types of modern furnaces used for melting brass are various; these are charged with coke, oil, and gas. Electrical furnaces are much in advance of the experimental stage and are being marketed with a great deal of success. Undoubtedly the electric furnace is the ideal method of melting brass, as the air is excluded and the melting loss or shrinkage is practically nil. The prohibitive initial cost of these furnaces with full electrical equipment has stopped many firms from installing them, but considering their efficiency as regards cleanliness, low upkeep, maintenance of constant melting temperature, thereby eliminating the possibilities of overheating, etc., they should prove a big asset to modern foundry equipment.

Temperature is pre-eminently the most important of the various factors which influence the quality of castings, and should be accorded the maximum of consideration in foundry practice. So marked is this factor that perfectly constructed moulds, poured with the best brass, can be the means of absolutely worthless castings due entirely to the state of the metal. The measurement of the temperature of molten metal should receive as much attention as the measurement of temperature of annealing furnaces; comparatively few foundries have a pyrometric installation, and those who do often lay very little importance on the data that may be obtained from its readings. In an article by Mr. J. Arnott on "Measurement of Casting Temperature in the Barss Foundry," he stated that a pyrometer which will be of real service to the brass foundry should have the following characteristics:—(*a*) It should be accurate within 1 per cent.; this means a maximum error of 10 deg. at 1,000 deg. C. (*b*) It should be capable of use up to 1,300 deg. C. if required. (*c*) It should indicate the temperature of the molten brass within at least one minute of immersion. (*d*) It should show a direct reading and involve no calculations whatever. (*e*) It should be strong and not easily put out of order; or, at any rate, it should permit of easy and cheap repair. (*f*) It should not be too expensive.

He (Mr. Arnott) recommends a base-metal thermo-couple protected by a nichrome sheath, which is connected to a galvanometer by compensated wire leads. We are strongly of the opinion that the immersion method for temperature determination is the only one of any use for molten metal; in our experience we find this method is by far more reliable, more practical, and cheaper than the optical, radiation or resistance pyrometers.

Brass castings are subject to various defects which are difficult to discover by surface inspection or even by hydrostatic testing when such a test is practicable. The defect which most commonly occurs results from the inclusion of oxide in the metal of the casting. This occurs in two ways: either the molten metal contains an admixture of oxides, owing to insufficient protection of the molten metal from the air, or the dross from the surface of the crucible or furnace charge gets into the mould and is caught at some point where the flow is slight, and is thus prevented from coming to the surface in the risers.

The oxide, formed during the melting by the action of oxygen and other gases from the air and furnace, is absorbed by the molten metal and greatly reduces the elongation and density. If a tensile test is impracticable oxidation in the metal may be discovered by making a bending test on a machined specimen. The presence of oxide will then be indicated by a number of small cracks which open on the outside of the bend, and if the oxidation is extreme, also by the abnormal colour of the surface of the fracture.

The presence of included dross is very difficult to discover generally; if a hydrostatic test cannot be made, it is practically impossible to find out such defects unless they happen to be near to the surface of the casting. When there is a considerable thickness of metal a hydrostatic test does not always discover such defects. The best insurance against this kind of fault is correct moulding, a matter, strange as it may seem, which is very unusual.

Since foundry sand is a poor conductor of heat, metal which has been taken to a high temperature will retain the heat concentrated in the liquid metal. Now the metallic oxides contained by the metal will be decomposed by the heat, and the result is that gases are created which cannot escape, as by that time the outer surface of the casting has solidified. There is, therefore, no means of escape; consequently, these gases form blowholes and cause honeycombing in the interior of the casting, thus materially impairing its physical (especially machining) properties. The utilisation of scrap (by itself) is not recommended, since it encourages the gas absorption and formation of oxides, and, in addition to this, the metal becomes thick liquid and is inclined to be brittle.

The designer and foundryman should work hand in hand; every brass or bronze casting should be designed with reference to a given position in the mould. The position being determined, the various portions of the castings should be so arranged that they are connected by a rising channel of increasing cross-section and with a minimum of offsets with one of the risers, which, of course, should be of much greater diameter than the thickest part of the casting. The reason for this is clear, since after shrinkage cavities would otherwise form in the heavier parts of the casting (these parts may be chilled).

The Use of Chills.

In brass casting chills are used on all enlarged sections in close proximity to smaller sections and connected thereto. If the sections are exceptionally large, a sinking head is placed on the top of the large sections; however, great discretion is necessary in the chilling, so that large chilled surfaces may be placed in a vertical position in order to prevent the metal kicking off these surfaces. When a casting is thus correctly designed with reference to the moulding, it is evident that

* Meta Industry Sept. 5, 1921.

there is much less likelihood of dross being caught in the mould, but that instead it will flow up into the risers. The foregoing presupposes, of course, that the pouring gate enters the mould at the lowest point. Illogical gating is the source of many troubles; mis-runs, pin-holes at the gate, drawing between light and heavy sections, exaggerated porosity, inclusion of dross, etc. These can be remedied. Whenever practicable, castings should be poured from the bottom; that is, the pouring gate enters the mould at the lowest point, and so any dross is prevented from being lodged in the mould, but flows up into the risers. There are certain castings which cannot be poured from the bottom, but it is a question whether castings poured from the top are ever quite free from dross. Hence, very important castings should be so designed that they can be poured from the bottom. The accomplishment of this will sometimes involve considerable expense, as the casting may have to be made much thicker than it need otherwise be, and perhaps also much machine work may be required to bring them down to the required thickness. In determining the position of the casting extensive flat upper surfaces should be avoided, as dross may accumulate by being caught under the flat surfaces of the mould or core. Should a flange form the upper surface of a casting, it may quite possibly contain some dross, and so sufficient allowance should be made so that any dross will be entirely removed during machining. Insufficient risers presents another source of trouble. Wherever dross is likely to collect in a casting a riser should be placed, if practicable; often expensive castings are scrapped because the moulder, prejudiced by consideration of economy, is in favour of few and small risers. It is wise, therefore, not to leave the decision as to the number and size of risers to the moulder. The casting should be made in full accordance with a drawing and specification, on which should be given the total cross-section of the risers in per cent. of the greatest horizontal cross-section of the casting, the number and position of the risers.

Metallurgical Considerations.

The question now arises what is the best way of eradicating the chief metallurgical defects; namely, blowholes and honeycombing, or the occlusion of oxides and gases in the molten metal. A deoxidiser is generally added—that is, a reducing agent which totally destroys all gases and oxides contained in the liquid metal, forming a scum which floats on the surface of the metal and can easily be removed before pouring. Carbon, phosphorus, magnesium will readily reduce oxide; magnesium is not only a good reducing agent, but also improves the strength and toughness of the castings. Brass castings fluxed with magnesium show a homogeneous close-grained structure, and, as regards other physical properties, about 6 per cent. increase in elongation and an increase in strength of 4 to 5 tons per sq. in. Considering the removal of other impurities—sulphur, iron, antimony—should the element or elements be deleterious to the properties of the resultant casting. Potassium cyanide, nitre and soda are desulphurisers. The volatile impurities, such as tin and antimony, evaporate at high temperatures, and nitre will generally remove most of the iron as a dross. Overheating of brass, either beore casting or during annealing, produces an interior oxidation, probably by the opening of fissures between the grains, and through this the strength of the material is greatly reduced and the ductility reduced almost to zero.

Swedish Iron Industry.—A report on the situation of the Swedish iron industry was read at a recent meeting of the Ironworks Association at Gothenburg, showing that the export of iron ore during the first seven months of 1921 amounted to 2,560,000 tons, or 660,000 more than during the same period of 1920. The export of different kinds of iron and steel during the same period of 1921 totalled 68,000 tons as compared with 162,000 tons during the first seven months of 1920 Statistics regarding the activity of furnaces and forges are depressing. Only 20 blast furnaces out of a total of 134 were working at the end of July, as compared with 66 in blast at the end of July, 1920. The steel works have only been producing spasmodically, foreign competition having caused a difficult situation in the industry.

Institute of Metals.

Properties of some Nickel-Aluminium—Copper Alloys.

By Professor A. A. Read and R. H. Greaves.

In some of the copper-rich nickel-aluminium-copper alloys the alpha solution will retain much more nickel and aluminium at 900 deg. C. than at ordinary temperatures. Alloys typical of the region comprised between the limits of composition of the alpha solution at 900 deg. and at ordinary temperatures have been examined. These alloys, while relatively soft on quenching from 900 deg., are hardened by slow cooling from that temperature or by reheating to lower temperatures. This change is the result of the appearance of a new constituent, the separation of which is accompanied by changes in the density and electrical conductivity of the alloy, in addition to its effect on tensile, hardness, notched-bar, and other tests. The separation of this special constituent takes place somewhat slowly, so that chill-cast alloys and hot-rolled rods of small section consist almost wholly of the alpha constituent. The cold-rolled rod, obtained by hot-rolling followed by a few passes in the cold, thus consists almost wholly of the alpha constituent.

On annealing the cold-rolled alloys, softening proceeds very slowly up to 500 deg., at which temperature precipitation of the nickel-aluminium-rich constituent begins to take place at an appreciable rate, with the result that with some compositions a progressive increase of hardness is obtained by holding the alloy at 500 deg. C. If the separation is sufficient, this may more than counterbalance the previous softening, giving an alloy of high elastic limit and tensile strength and good elongation (*e.g.*, a maximum load of over 50 tons per sq. in. with an elongation of 20 per cent.). The rate of cooling from a temperature above that at which the alpha solution begins to deposit the special constituent has a great influence on the mechanical properties of the heat-treated alloys. The hardest product is, however, obtained by reheating the quenched alloy for some time at 600 to 700 deg. C. (say, two hours at 600 deg., or half-hour at 700 deg.). The alloys so treated generally give better properties than are obtained by any uniform rate of slow cooling (*e.g.*, yield point over 20 tons per sq. in., maximum load over 40 tons per sq. in., elongation about 15 to 25 per cent.). The heat-treated alloys show considerable endurance under alternating stresses above their true fatigue limit, the determination of which involves a number of prolonged tests.

Constitution and Age-Hardening of the Alloys of Aluminium with Magnesium and Silicon.

By D. Hanson and Marie L. V. Gayler.

The constitution of a small portion of the ternary system, aluminium, magnesium, silicon, has been investigated, namely, that containing up to 35 per cent. magnesium and 11 per cent. silicon. The results of thermal curves and microscopic examination prove that in these alloys magnesium and silicon form a chemical compound having the formula Mg_2Si. This compound and aluminium form a eutectiferous binary system, having a eutectic containing 13 per cent. of Mg_2Si, and melting at 590 deg. C. Two ternary systems are formed with silicon and magnesium respectively. The aluminium—Mg_2Si—silicon system possesses a ternary eutectic that melts at 550 deg. C.; the ternary eutectic of the aluminium—Mg_2Si—magnesium system melts at 450 deg. C.

The alloys of this system, after quenching from high temperatures, are relatively soft, but gradually become harder; this age-hardening ceases after a few days.

Messrs. H. Broadbent and J. H. Broadbent, engineers, Commercial Road, Dewsbury, Yorks., have dissolved partnership.

The Marseei. Engineering Company, Limited, are being wound up voluntarily, with Mr. E. F. Peirson, 17, Hertford Street, Coventry, as liquidator.

The partnership heretofore subsisting between Messrs. W. Barnett, F. Saunders, and P. J. Thompson, carrying on business as engineers, at Dixon's Green, Dudley, under the style of the B.S.T. Electric Fittings Company, has been dissolved.

Constructing Patterns to Favour Moulding.

By Joseph Horner.

Pattern details of a trifling character will sometimes throw extra work on the moulder, if the pattern is constructed in some conventional way which may not happen to be the best applicable in this particular instance. The subject is many-sided, and it can be illustrated with some examples, the extended applications of which are as wide as the practice of the trade.

Jointing. — Foremost among the helps or hindrances to moulding for which the pattern-

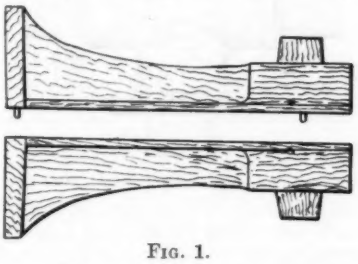

Fig. 1.

maker is responsible is that of the method of jointing adopted. In the majority of cases there is no reasonable alternative. A glance suffices to indicate where and how the jointing should be done. It is not always necessary that the pattern joint shall coincide with that of the mould. And in the case of solid patterns the mould has to be jointed, although the patterns are not. Nor is it only the general plane of jointing that is con-

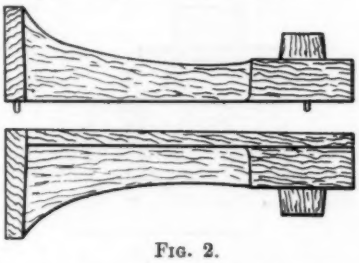

Fig. 2.

cerned in all cases, since pattern fittings impose modifying conditions. The forms and locations of core prints, the making fast or leaving loose of parts, the depths of lifts, coming in copes are all affected by questions of jointing. The illustrations following, though elementary, are very frequently associated with other details that exercise modifying influences.

The bracket in Fig. 1 is a common form which, differently proportioned, may be moulded in

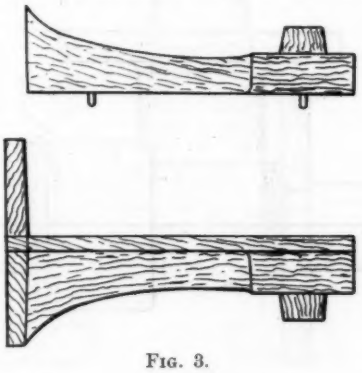

Fig. 3.

several ways. A usual method adopted is to divide the pattern along the middle plane as shown, and mould exactly one-half in bottom and one in top. The division is made along the centre of the main web, but the pattern is stronger if unjointed there, but instead, along the top face of the web, as in Fig. 2. The pieces that form the upper portion—foot, boss, and connecting rib—are then fastened together, and dowelled on the main web.

In both these cases the mould is jointed along the plane of the pattern joint, and the moulder generally prefers to have it so. In consequence of rapping, the face of the foot will not be quite true in the casting, but a straightedge will rock when laid across it. If the foot has to be tooled

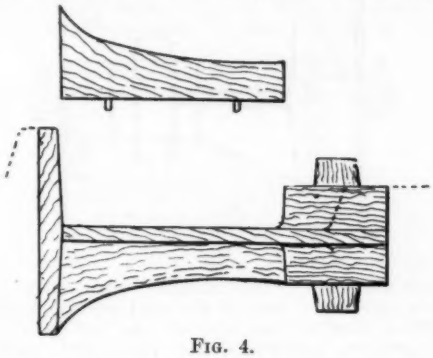

Fig. 4.

this is of no moment. Fig. 2 is a stronger pattern than Fig. 1, and the fin that forms in the joint will come on the upper face instead of leaving a mark, and perhaps a lap around the centre of the web.

Such a pattern is often made as in Fig. 3 with the foot unjointed, the web solid, and the upper portion of the boss and the rib only left loosely dowelled. Then the face of the foot will be truly

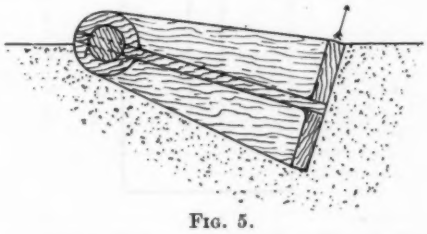

Fig. 5.

plane, but a sloping sand joint, indicated, has to be made by the moulder. The pattern is often made with an unjointed foot, Fig. 4, and the top boss fast, in which case the sand joint is brought along the top faces of boss and foot, along the face of the main web, and around a portion of the boss, indicated by the dotted line there. Only the upper rib is loosely dowelled to come into the top. This pattern is stronger than the others, but a little more work is involved in making the sand joint. Another method, not illustrated, is to

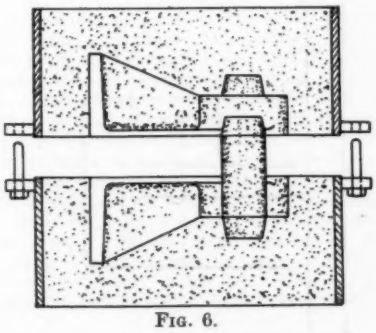

Fig. 6.

divide the pattern along the middle plane at right angles to the planes illustrated in these figures, which is a suitable form of jointing. There is little or nothing to choose between this and those shown in the previous figures. Here also there are three methods. The pattern can be jointed along the centre of the web, or it may be made solidly, or the upper portion of the boss, foot and rib may be left loosely dowelled. An alternative to all these is shown in Fig. 5, where a solid pattern is moulded in the diagonal direction. The

sand in the cope comes down the inner face of the upper half of the foot, along the sloping top face of the web, and round the upper portion of the boss. After the cope has been lifted the pattern is withdrawn in a diagonal direction.

Figs. 6 and 7 illustrate sections through two bracket moulds. The first corresponds with the pattern construction in Fig. 1, the second with that in Fig. 4. The sloping sand joints in the

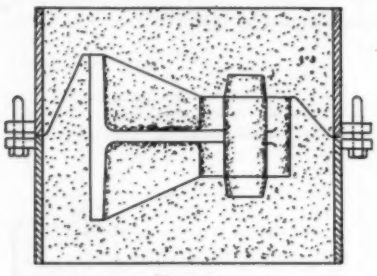

Fig. 7.

latter are rather objectionable, since they are liable to cause a crush of the sand during closing.

These brackets are treated as self-contained independent patterns. But these and similar forms are often subsidiary portions of larger patterns. It may then happen that shapes of which these are typical will come in the bottom, or on the sides of moulds, in which cases neither of these methods would be practicable. Fig. 8 shows a bracket-like fitting lying vertically in the

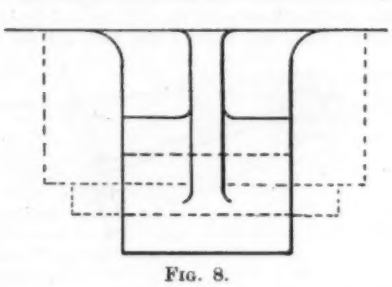

Fig. 8.

bottom of a mould. It would not do to make the boss pieces loose, skewered on the vertical web, because their thickness is too great to permit of their withdrawal into the web space. The only way is to cover them with prints outlined, the cores for which will include the ribs, and the upper halves of the bosses, the lower halves of bosses and prints being made in the pattern.

The typical bracket often occurs on the sides of castings, Fig. 9. If these are made like the

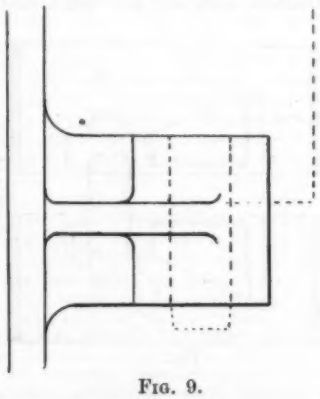

Fig. 9.

castings, they give trouble to the moulder in jointing down the deep vertical faces, since the bosses prevent the withdrawal of the pattern horizontally, even though the lifting out of the main pattern should leave a clear open mould space. And drawback plates could not be used in this case. The patternmaker should therefore provide for taking out the upper portions of the bracket with a core, fitting a print, outlined, to come to the top of the main pattern, extending from thence to the upper face of the main web of the bracket. The upper portion of the bracket is then inserted in the core box. Cases allied to this are of constant occurrence.

Flanged articles, cylindrical and rectangular, give rise to problems of jointing. Always a long cylindrical pattern is moulded with its axis horizontally, even when, as frequently happens, it is set vertically for pouring. The semi-circular shape

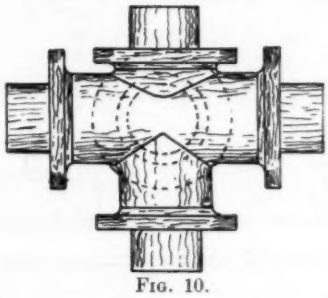

Fig. 10.

is the best possible for clean delivery. But it may occur with some short cylinders of large diameter that moulding has to be done vertically, because of the presence of attachments which would be inconvenient to mould in the horizontal position. These occur in many engine cylinders made from full patterns, from skeleton patterns, from loam patterns, and swept up in loam. In some pipe moulds and in cock and valve bodies similar difficulties arise. Elementary examples are shown in Figs. 10 to 12.

An ordinary pattern cross is jointed, Fig. 10, or

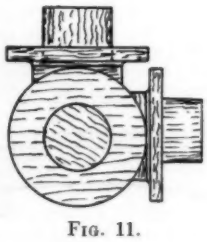

Fig. 11.

a tee, in one longitudinal plane, just as a plain cylinder would be. But if a branch or a foot, or both, stand out at right angles, Fig. 11, or as dotted in Fig. 10, something has to come into the top or bottom, or in both, if there are two branches, which at once entails additional jointing for delivery. In these cases the patternmaker should leave the flange loose, encircling its branch,

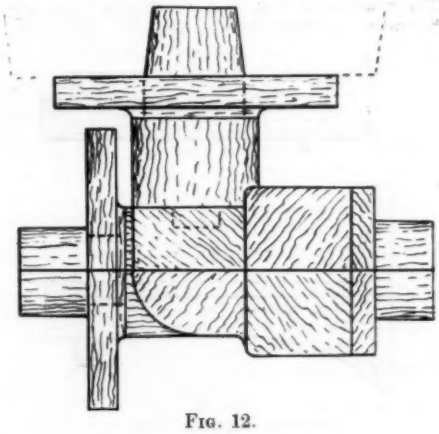

Fig. 12.

Fig. 12, so that when the main pattern has been delivered the flange will be left behind. The rest of the work then devolves on the moulder, whose task would be lessened if the flange had been covered with a print fitted below it, and a core box made to correspond, to include the branch. But this would entail a good deal of work, since the core would have to complete as much of the outlines of the main pipe as the core would cover. Usually, therefore, unless a large number of cast-

ings is required, the moulder brings the flange, left loose, up into the top, makes a joint along the outer face of the flange, Fig. 12, and after delivery of the flange covers that face with a plate of loam cake, or a core rammed in a box. It is necessary to select a flask having an open space between stays large enough to admit the flange

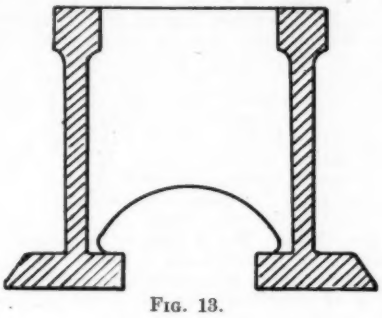

Fig. 13.

and its covering cake. The cake or the core is used because it is simpler than ramming another flask over the area occupied by the flange. The jointing is indicated in Fig. 12.

If the branch or foot comes in the bottom, then another box part must be used, jointed either along the back of the flange or its face. The flange is either loosely dowelled to the pattern or encircles its print.

A very large group of patterns is typified by the

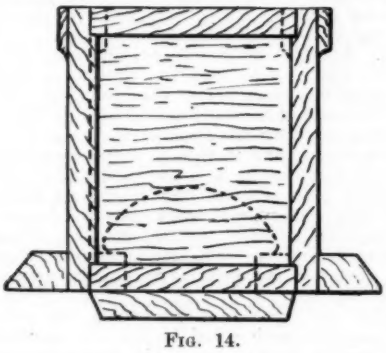

Fig. 14.

forms in Figs. 13 to 16 being in the main rectangular in section, with flanking flanges, and a hollow interior, with or without flanges. The proper way in which to make the pattern is to mould as in Fig. 13, with the flanges lying horizontally, in which case the interior can generally deliver without coring. The lower face having to be tooled determines its being cast downwards. if the bottom flanges are not very wide they can

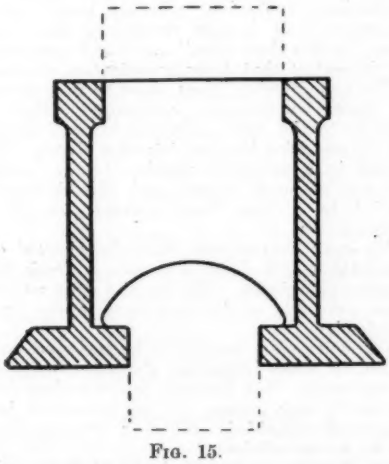

Fig. 15.

be skewered, or dovetailed, on the sides to be withdrawn inwards. This cannot be done if they are very wide, but the mould must be jointed over them, leaving them in a bottom box, or bedded in the floor. Generally, the interior will deliver without dried cores, with saving of cost. But if the space is narrow, and when numerous cross ribs occur of awkward shapes, prints are put on, Fig. 14, and the spaces cored.

To make patterns of this class to mould on their sides, Fig. 15, is not desirable. The flanges would cause no trouble in delivery in top and bottom, would not be so good as that in the previous Fig. but the interior even in the simplest shapes must be cored, and the support afforded to the cores Some chapleting might be required, and thicknesses may not come out uniform. Neither would the faces to be tooled be so sound.

When a bed section has wide flanges uncompli cated with other matters, Fig 16, it moulds in the

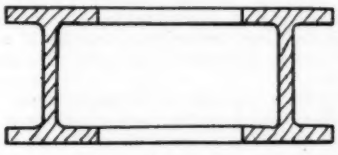

Fig. 16.

position shown. The width of the flanges renders withdrawing inwards impossible. It is not desirable to core the wide interior, assuming that it is not characterised by intricacy of detail. The best way is to leave the bottom flanges loose, and make a sand joint over their top faces. The flanges can be included in a lower flask or in the foundry floor.

Book Reviews.

Materialprufungswesen. By Prof. K. Memmler. —Berlin: Walter de Gruyter & Company, Genthinerstrasse 38, W.10. (Price 1s. 6d.)

This a small book, about 4 by 6 in., in the well-known Göschen Series (No. 311), and forms Part I. of an elementary treatise on the modern practice of testing materials. It is divided in three sections, in the first of which the physical characteristics of materials are discussed; Section II. deals with the various forms of testing materials, while Section III. describes the various machines and implements used in testing. Section II., in turn, is divided into five sub-sections, which deal respectively with (1) static loads; (2) dynamic loads or shock tests; (3) endurance tests; (4) miscellaneous tests, such as cold and hot bending and forging tests, testing wires, and testing tubes by internal pressure; (5) tests for hardness. The book extends to 160 pages with 58 illustrations in the text and an index. There are several bibliographies giving the representative literature of the subject dealt with under the different headings. The book is in its third edition.

Die Maschinenelemente. By Friedrich Barth.— Berlin: Same publishers. (Price 1s. 6d.)

This is No. 3 in the same Series, and is the fourth edition of a brief treatise on machine elements. After a short introduction, giving definitions of the various terms used and the elastic limits and ultimate strengths of the various materials used in machinery construction and discussing the general viewpoints in dimensioning and designing machinery parts, these are in turn dealt with in detail in seven chapters, as under:— (1) Connections by wedges, screws, rivets, etc.; (2) shafts, journals, and bearings; (3) couplings, clutches, etc.; (4) transmissions of rotary movement; (5) pistons, piston rods, crossheads, and stuffing boxes; (6) cranks, connecting rods, eccentrics; (7) cylinders, tubes, and valves. The volume extends to 136 pages, with 114 figures in the text.

Strength of Paper.—According to Dr. A. Klein, if we take a paper of 0.05 mm. thickness and 40 grm. per sq. in. weight, the absolute breaking stress is 9 kg. (about 5.75 tons per sq. in.). If we now compare the various sorts of iron, we find that the breaking stress per sq. in. is, for cast iron, 15 tons, wrought iron 26 tons, and for steel 30 tons. Thus we find that linen has a greater strength than mild steel, cotton greater than wrought iron, wood cellulose in its natural length greater than cast iron, and paper about 40 per cent. the strength of cast iron.

XUM

Foundry Reorganisation.—Part III.

By H. W. J.

The reorganisation of the foundry office is necessary in the interests of economical production, and this must be taken in hand without delay. Too long has this essential been neglected, and inefficiency here has undoubtedly contributed to the present undesirable state of affairs.

A bad office is a liability; a good office is an asset. This is being recognised by the engineering industry generally, but, as usual, the foundry section appears to be lagging. The average foundry office is a disreputable-looking affair, and a spring cleaning, first of the place itself and then of the work performed therein, is eminently desirable.

The foundry manager is no paper man. He has not studied book-keeping, and his office is littered with blue prints and letters, whilst an accumulation of patterns and sample castings contribute to the general disorder of the place. His office, as a matter of fact, is used for the purpose of discussing the merits or demerits of castings or patterns, and so long as one chair is available for his own use, and sufficient space on his desk to enable him to make a few notes, he is quite content.

It may be argued that this is quite a business-like arrangement, and if it were methodically conducted no doubt it would be so. Unfortunately, however, method is hardly ever apparent, and a dusty, grimy room, littered with a conglomeration of odds and ends, is not likely to create a favourable impression in the mind of the visitor.

For the foundry manager must have visitors, of course, present clients and prospective ones, and these are the visitors who should be encouraged. The buyer nowadays likes to be in personal touch with his supplier, and it is necessary that he should be favourably impressed. There is more in this than is generally supposed, and the sooner it is realised the better.

Why should the foundry manager have all these evidences of his calling about him? Surely it is not necessary that this glorious confusion of castings and patterns should abound in his office. In the office of the manager of any engineering factory no such confusion prevails, and yet that manager is in as close touch with his product as the foundry manager is with his.

First impressions are important, for orders can be obtained or lost on them. The prospective buyer enters the dingy compartment termed by courtesy the "manager's office," and his first unspoken comment is, "What a hole!" The absence of any method or system shakes his confidence, and his mind is more than half made up before he has been in the room ten minutes. The undoubted practical ability of the manager, as evidenced by his conversation, cannot altogether eliminate that first impression, neither can the fragrant cigar nor the soothing whisky and soda restore his equanimity.

In order to obtain business the buyer's confidence must be gained. He must be convinced that the foundry can do what is claimed on its behalf, and all the talking in the world will not undo the mischief wrought by that view of chaos and confusion.

So let us have a clean office, and a methodical office. The manager need not be a "paper" man in order to achieve this. We must first of all get rid of that sand and dust which persistently settles upon everything, even if it means the removal of the office to another part of the building. It may be that the office is placed so as to allow the manager to overlook the foundry, and he is not desirous of quitting his point of vantage, but even if this be so, a slight alteration, such as changing the position of the door, will no doubt yield the desired result. In any case, the office is to be clean, no matter what steps are necessary.

Next, we get rid of that miscellaneous assortment of patterns, for there is no necessity for their presence in the manager's office. Should a foreman wish to consult him about any pattern, or to bring to his notice any defect, he must, of course, bring the pattern to the office, but why should it be left there? The fact that it is suggests that the manager cannot give a decision, and to the prospective buyer this is a factor of some weight.

It is not suggested that in every case the manager can give an immediate decision, but it is not too much to expect that he knows sufficient of the job to enable him to give a later decision from the few notes that he makes, so that the pattern can be returned to the store-room to await the verdict. This is the sensible course to pursue, for it is methodical, and therefore prevents confusion. In the matter of castings, too, these need not be littered about the office in order to proclaim that castings are produced. If it is desired to have sample castings on view, a show-case is the proper place for them, although one or two may be placed in the office where they may be handled by the visitor. But a heap in one corner, and a dozen or so thrown upon a desk or table, is not the kind of thing to impress favourably the visitor, and so all superfluous samples should be taken away and stored (if desired) elsewhere.

Incoming correspondence should be placed in a basket set apart for the purpose, and outgoing correspondence similarly treated. There should also be a basket for the letters and notes to be sent to the various foremen. In no case should the manager's desk be littered with papers. If certain correspondence cannot be dealt with immediately, this should be placed in a basket marked "For attention," and the contents of this basket could then be perused by the manager at his leisure.

It is sometimes necessary for blue prints to be on view for some little time, but even so, there is no reason why they should cover the manager's desk. A table or drawing board should be placed within easy reach, and this would accommodate the drawings much better than the desk, and they could remain there undisturbed until finished with.

Linoleum upon the floor of the room will be an improvement, and if this is swept frequently and washed occasionally, and the furniture dusted each morning just prior to the manager's arrival, it will have a wonderful effect upon the health, temper and activities of the manager, his efficiency is increased, and the first impression of the prospective customer is conducive to happy business relations.

What has been said concerning the manager's office applies with equal force to the general office—if one be in existence. The doubt expressed is due to the fact that, in many foundries, the clerks are accommodated in a foreman's office situate in about the dirtiest part of the foundry. However small the foundry may be, there should be a general office, for without this it is almost impossible to develop the administrative side of the business.

It need not be a large and elaborate office, but one just fitted for the requirements of the foundry. System does not mean an unwieldy organisation, but rather a methodical handling of the factors governing production, whether these be clerical or manual. It is now recognised that "prevention is better than cure," and it is by proper system at the outset that later troubles are eliminated.

The general office, then, must be in evidence, and it must be properly systemised. This applies equally to the office tenanted by one clerk, as to the larger office housing ten or a dozen. As mentioned in a previous article, "costs" constitute the predominant factor, and this factor is controlled to a very large extent by the office organisation.

We may assume now that the general office is respectable and clean, and not a death trap for consumptive clerks. The foundry office must be free from reproach, if the maximum results are to be obtained.

The office staff must next be reviewed, and here again, in many instances, a drastic reorganisation is necessary. Not that the foundry clerk is incompetent by any means, but his education has been somewhat one-sided, and as a consequence he is by no means efficient.

The foundry manager does not like clerks, but as there is clerical work to be handled he must perforce get someone to do it. The easiest way is to pick out an intelligent foundry labourer and put him into the office, giving him a little elementary tuition, and then leaving him to his own devices. This is often done, for it is argued

that, at all events, the man has inside foundry knowledge, whatever may be the limitations of his clerical qualifications.

There *are* well-trained foundry clerks, of course, but they are to be found only in the well-organised foundry. The labourer-clerk still holds sway in a great many of the small foundries, and, as a consequence, the book-keeping and costing are of a very elementary character. His duties are many and varied, and often include the making out of work cards, control of the pattern store, compiling of wages sheets, and the weighing of material.

But there is little attempt at instituting an efficient book-keeping and costing system, and, indeed, with such clerical assistance, it is difficult to see how the attempt would succeed. The manager himself probably does what costing is considered necessary, but, taking into consideration the other calls upon his time, and his lack of real clerical ability, efficient costing is out of the question.

This naturally affects the estimates, and, as a result, orders are lost on account of the high figure charged, or are gained at a figure which yields no margin of profit. More will be said on the matter of costing in a subsequent article—for the moment we are clearing the ground to make the institution of a costing system possible.

Each foundry clerk must be well trained, and must specialise in one direction. In the engineering factory will be found specialised clerks—cost clerks, book-keepers, progress clerks, and the like, and the same principle must operate in the foundry. The general clerk has no place in the modern factory organisation—he has disappeared with the "all-round mechanic—and the factory clerk to-day is not a general utility man, but a specialised individual, responsible for a definite phase of the organisation, knowing exactly the extent of his responsibilities, where his duties start, and where they end.

The sectionising of the foundry office depends to a very great extent upon the variety of manufacture and the methods employed. Assuming that the foundry under consideration caters for the needs of various factories, some diversity of manufacture may be expected, and the office is organised accordingly.

As it is presumably a small office, one clerk can handle the book-keeping and costing, and he has nothing to do with the actual foundry procedure. He obtains his figures for costing purposes from an authentic source, and the accuracy of his records depends largely upon the ability of the shop clerk, or progress man, whose business it is to see that the system is adhered to in the foundry.

It may be that manufacture is divided into two classes, viz., repetition work and specialised work. In connection with the former it is quite possible that at least one-half of this work is to the order of but one or two customers, order following order automatically, whilst the other half is to the order of a large number of customers, to be executed upon a competitive basis.

The specialised work consists of but one or two castings off any one pattern, and although the actual volume of output is comparatively small, the work entailed is proportionately great, especially so far as the clerical side is concerned. Two courses then are open to the foundry manager in organising his staff, namely, (1) for one clerk to handle the work in connection with the repetition orders, and another to be responsible for the orders for specialised work, and (2) for one clerk to deal with all shop matters in the office, and another to be more closely associated with the shops in connection with the whole range of manufacture.

This, however, must be left to the discretion of the manager, but whichever course is adopted, we have at all events decided that the reorganisation of the foundry office cannot be longer delayed, if satisfaction is to be achieved.

Some of the spelter works are prepared to follow the example of Guest, Keen & Nettlefolds, Limited, in regard to the unemployment question, provided they can obtain the raw material to work on. If the Government will sell the zinc concentrates to the companies at a price warranted by the market price of spelter, at least two of the most important of the works are prepared to begin work at a loss.

Loco Frames of Cast Vanadium Steel.

Mr. Harry Brearley, in the recently published second edition of his book on "The Case-Hardening of Steel" is evidently not very much impressed with the merits of vanadium. He admits that it undoubtedly acts as a hardening element, and, other things being equal, increases the yield ratio and actual hardness; but if money is available it can generally be spent more profitably—he does not state in what way—than by adding vanadium to chromium steels. He held the same opinion in 1914, when publishing the first edition of his book, and the value of vanadium has evidently not improved in his estimation since that date. His objection is evidently prompted by the high price of the metal. So much by way of introduction to our subject.

Next we must explain that over 90 per cent. of the vanadium produced in the world has so far come from the famous Minas Ragra, close to the Cerro de Pasco in Peru, and that all the deposits of any importance in that country are owned and worked by the Vanadium Corporation of America (120, Broadway, New York City) since they have bought out the Primos Chemical Company on January 1, 1920. Hence the Corporation practically has the world monopoly of the metal.

The Corporation have recently published an illustrated pamphlet entitled "Vanadium (the Master Alloy) in War and Peace," from which we take the following interesting particulars relating to vanadium cast steel loco frames. It should be explained that in this country loco-builders use plate frames made out of a thick rolled steel plate. In America, on the other hand, they use so-called bar-frames of cast steel. In a recent pre-war contract for locomotives to an American design, the British builders did not attempt to cast the frame, but worked it out of a thick rolled steel plate weighing 8 tons, as received from the mill. The plate was whittled down so that when finished it weighed only about 2 tons.

The Vanadium Corporation in their pamphlet publish some interesting particulars about cast-steel frames, for which purpose vanadium steel has been used for some time. The possibilities in the way of eliminating frame failures, we are told, through the use of vanadium steel with its elastic limit of useful strength much higher than that of carbon steel were more than apparent, as well as the possibilities of keeping pace with the increasing size and power of locomotives without unduly increasing the weight of the frame. By 1917 over 65 per cent. of the locomotives weighing over 200,000 lbs. (over 88 British tons) were built with vanadium cast-steel frames.

The average of the tests of a lot of seventy-one vanadium cast-steel frames recently made by the Union Steel Casting Company, Pittsburgh (U.S.A.), was as under, typical average of the physical properties of carbon-steel locomotive frames is added for comparison:—

	Vanadium steel.	Carbon steel
Elastic limit ... Tons per sq. in.	20.2	16.6
Tensile strength " " "	35.2	22.0
Elongation in 2 inches...Per cent.	24.7	27.4
Reduction of area ... "	46.4	47.0

At the Shipping, Engineering, and Machinery Exhibition, at Olympia, London, W., last week, a dinner was given to commemorate the successful co-operation of employers and workers. Captain H. Riall Sankey (president of the Institution of Mechanical Engineers) was in the chair.

The autumn meeting of the Refractory Materials Section of the Ceramic Society, was held in the hall of the Institution of Mechanical Engineers on October 6 and 7, Lieut.-Colonel C. W. Thomas presiding. The following papers were read:—"Refractory Materials of the London Basin," by Mr. H. Dewey; "The Marlow Gas-Fired Tunnel Oven," by Mr. J. H. Marlow; "A New Type of Tunnel Kiln, Oil Fired," by Mr. P. J. Woolf; "Aluminothermic Corundum as Refractory Materials," by Dr. A. Granger; "The Reversible Thermal Expansion of Silica," by Professor J. W. Cobb and Mr. H. S. Houldsworth; Symposium on Gas Firing. A dinner was held in the evening. On the following day a visit was made to the National Physical Laboratory, Teddington.

XUM

Chilled Flour-Mill Rolls.

Mr. G. O. Vair contributes to a recent issue of the "Canadian Foundryman" an interesting article on casting chilled rolls such as are used in the process of grinding flour. These rolls must be perfectly true and free from defect. In addition to this, they must be hard and close grained enough to stand up against the continuous wear of grinding the grain. The rolls are cast in chills.

What constitutes proper iron is a matter about which opinions differ. However, an iron to make a good roll should be low in silicon and sulphur, and the combined carbon will automatically be high enough. If iron containing silicon 0.8, phosphorus 0.6, manganese 0.4, sulphur 0.04 is melted in a fast-melting cupola with plenty of fuel and blast, the resultant metal should make clean sound castings with good wearing qualities.

The production of chilled castings depends on the initial effect of several causes: (1) the quality of the iron, (2) the thickness of the casting, (3) the temperature of the iron at the time of pouring, and (4) the conditions of temperature of the iron mould, which has a greater effect in "striking in" when the mould is heated than if quite cold. A cold mould does not generally chill so readily as one which has been heated nearly to black hot, but the reverse conditions will sometimes occur with some brands of cast iron.

The accompanying drawings illustrate a class of chilled roll that is universally used in all mills in both Canada and the United States for grinding flour. The rolls are 10 in. in diameter, and in lengths of from 18 to 30 in.

The machine shop practice in making these rolls can be briefly described as follows:—Both ends are cut off and are drilled and bored at the same time. The shafts are next fitted and put into place by hydraulic pressure. The rolls are next taken to a lathe, and the shafts finished. The next move is to grind the chilled roll in a special machine constructed for that purpose, the tool used being a piece of hardened steel with square edge. This does not cut, but in reality scrapes the roll to the proper size. After being brought to approximately the right size, the roll is ground with an emery wheel, which brings it to the exact size and makes it perfectly true, after which it goes to the corrugating machine and the periphery is covered with shallow spiral corrugations.

As these castings require to be clean and perfectly free from flaws when finished, one of the most essential features in regard to the moulding and casting of them is the use of a correct type of pouring gate. The temperature of the iron should also be given due consideration, as it is impossible to get a casting of this description to finish clean when poured with metal that has become too dull in the ladle, and on the other hand it will not improve conditions to have the iron "just right" and then have the pouring gates "all wrong." The sketches herewith show sectional views of two different methods for casting and gating these skilled rolls.

Fig. 1 shows the roll cast solid, and is the way a Canadian foundry successfully cast their rolls. In Fig. 2 is seen the same class of roll as made in an American foundry with equally good results.

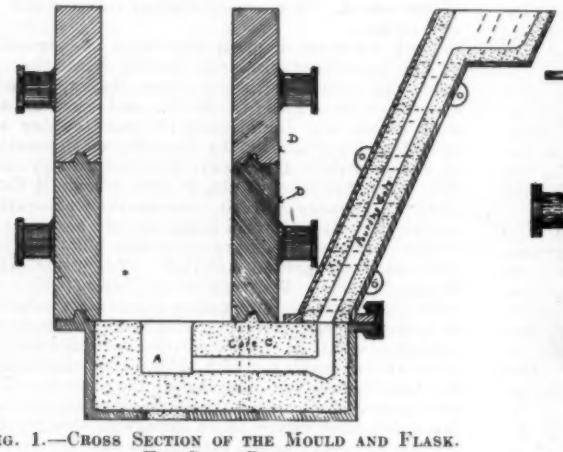

Fig. 1.—Cross Section of the Mould and Flask. For Solid Roll.

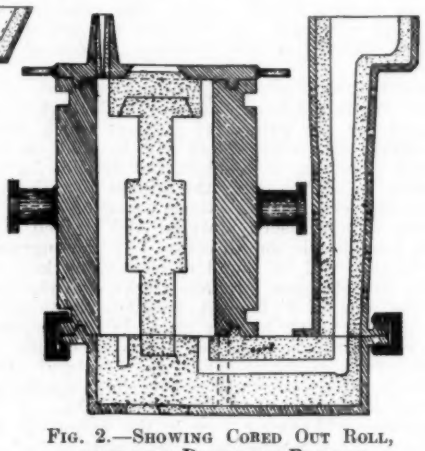

Fig. 2.—Showing Cored Out Roll, made by a Different Process.

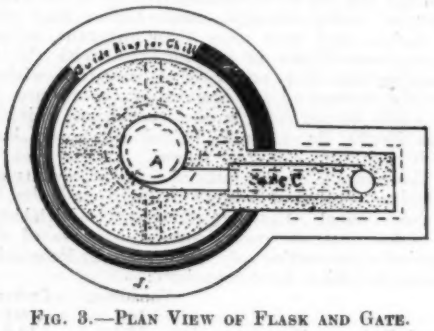

Fig. 3.—Plan View of Flask and Gate.

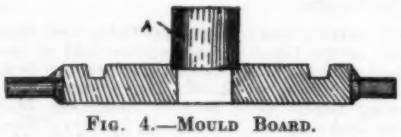

Fig. 4.—Mould Board.

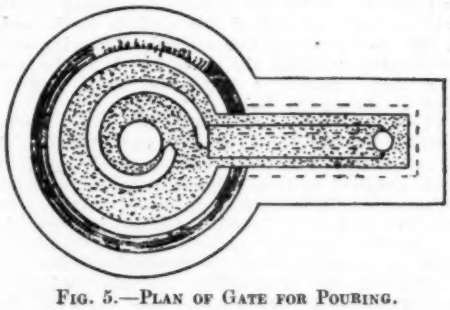

Fig. 5.—Plan of Gate for Pouring.

Fig. 3 shows plan of flask and pouring gate used for a solid roll. In Fig. 4 is seen follower board to receive hub needed, being the hub (A), and gates. The casting proper is formed entirely in the cast-iron chills (D) (D).

By referring to Fig. 3, it will be seen that the pouring gate is cut on a tangent into the hub (A), thus giving the desired effect to produce a swirl to the molten metal.

The roll shown in Fig. 2 is made in practically the same way as the solid roll, with the exception that it is cored out at the centre and covered with a cast-iron plate, continuing a pocket for a cheek rider. The spiral gate had to be adopted in pouring this roll on account of using a centre core (see Fig. 5).

The sand used for the gates is a dry sand mixture of about one part moulding sand, one part bank sand, one to sixteen of coal, wet with clay

wash. All gates and pouring basins are black-washed and dried. In black-washing the gate and pouring basin a successful and economical method is to place the same over the black-wash tub, letting it down on to a couple of clamps. A piece of shingle or any flat plate is blocked up against the under side of the gate, when the gate and basin will be filled with black-wash. The plate is now removed, allowing the wash to run into the tub, leaving just sufficient to make the gate and basin well washed and saturated so that when dry the iron cannot cut them.

To attempt to give formulæ of metal for rolls would be difficult, but as an example of what had been used where the author had been employed the following may serve as a guide:—One receipt called for 1,000 lbs. of No. 4 charcoal iron, 500 lbs. of chilled car-wheel scrap and 500 lbs. of Cranberry pig-iron, which is a high-grade silicon iron low in phosphorus and sulphur.

Another receipt called for 800 lbs. of charcoal pig, 600 lbs. of car-spring steel, 200 lbs. boiler punchings, 400 lbs. gates from this mix, and 82 lbs. of ferro-manganese. The ferro-manganese was melted in a crucible and poured into the ladle at tapping time.

White pig is not to be recommended, as it is apt to be high in sulphur, which, while being hard, has too many other qualities which are objectionable.

Damascene Steel.*

By Colonel N. T. Belaiew, C.B.

(*Abstract.*)

In the author's opinion a marked analogy exists in the structure and in some of the properties of high-speed and damascene steels, and a comparative study of both might therefore prove profitable in explaining certain properties and in opening new vistas.

Damascene steel belongs to the hypereutectoid series of carbon steels. The average carbon content of typical damascene articles must be about 1.5 per cent. That amount of carbon, however, does not exist as such, but as a definite chemical compound, Fe_3C or cementite, as one part of carbon produces fifteen parts of cementite, 1.5 per cent. of carbon in steel represents 22.5 per cent of cementite, which, from the practical point of view, is a very large amount. About one-half of this amount (11.5 per cent.) forms the excess, or free cementite. The other 11 per cent. of cementite with a corresponding amount of ferrite is used in building up "pearlite."

The free cementite is coarser than the eutectoid cementite, its spheroidisation is correspondingly more difficult and necessitates repeated hammering and heating. The greatest care must be taken to break the large cementite needles into smaller particles and afterwards to cause their complete spheroidisation.

The author's first Paper showed what a large amount of mechanical treatment (as shown by the macrostructure of the blade) was required to attain such complete spheroidisation. The macrostructure shows also that the cementite veins run closer up to the edge, and that therefore the Oriental maker must have relied most upon securing the best cutting properties of the cementite particles. High-speed steel is a tool steel which possesses the property of maintaining its hardness at a relatively high temperature. This property is secured in a large degree by adding tungsten and chromium. This steel belongs to the cementitic (carbide) series; its structure, when annealed, presents a striking similarity to the structure of damascene steel. Spheroidised carbide particles are embedded into a sorbitic matrix. To produce "high-speed hardness" such steel has to be heated to a very high temperature, and then quickly cooled. A certain amount of carbide remains undissolved, even after rapid cooling from temperatures close to the melting point. There are even indications that a moderate amount of free carbide appears to increase the cutting properties of the tool.

The makers of high-speed steel, however, emphasise that the making of the high-speed structure begins under the hammer; that during this operation "the massive carbides and tungstides present in the ingot are broken down and uniformly distributed throughout the billet"; and further, that "to accomplish this the reduction in area must be sufficient." Therefore, ingots are first hammered into billets, the billets are again slowly heated and then hammered for a second time ("cogged") —all this "mechanical treatment" being indispensable in paving the way to the "heat treatment" by properly breaking and evenly distributing the carbides (and tungstides) throughout the steel.

A comparison of the two processes—the "high-speed hardness" and the "damascene" process—shows that both start with a cementitic steel; both require the greatest care in breaking and evenly distributing the carbides under the hammer; in both cases the amount of mechanical work spent on a given article is very large, but however large, it is considered indispensable before a suitable heat treatment may be effected. In both cases the structure of carbides is spherolitic, whilst the matrix, after the heat treatment, is martensitic. In both cases also the cutting properties of the edge are related not only to the matrix, but to the carbides as well.

The few conclusions that can be drawn are:—

In damascene steel the degree of spheroidisation is always very high. That spheroidisation, however, was not an end in itself for the ancient maker, but was attained, so to say, incidentally during the numerous cautious forgings and heatings, when the greatest ductility was sought and obtained.

In high-speed steels that spheroidisation is also attained, but it seems to the author that insufficient stress has been laid on that point, either by the high-speed steel maker or user. He believes that a scientific application of the spheroidising process would help to improve the qualities of high-speed steel. An Oriental maker would never manufacture a steel article without having satisfied himself, by studying the watering, that the distribution of the carbides is the best possible and quite in accordance with the shape and properties of the article. Neither would he find a buyer ready to accept a sword or a tool without a proper "metallographic" examination of it as a whole (towards that end the splendid Oriental watering lent itself so well). The author therefore believes that a proper examination of the "watering" of high-speed steel, either in billets or in the finished article, will prove useful.

* Paper read before the Autumn Meeting of the Iron and Steel Institute.

Blast-Furnace Dust.—It is calculated that in the United States, with normal production, 1,700,000 tons of dust-catcher dust is re-used per year, while 1,800,000 tons are not accounted for. This quantity is mainly shot into the air. It is estimated that of the 1,800,000 tons mentioned, probably 1,500,000 tons are never recovered. This 1,500,000 tons yearly loss of flue dust would be equivalent to about 1,350,000 tons of ore, or about 700,000 tons of pig-iron. For the so-called average 500-ton stack it totals 11 tons of pig-iron lost per day—with whatever that means in cost of equivalent tonnage of ores delivered to the furnace top and lost profits in the pig-iron tonnage in question. The reduction of these losses is a practical problem, and one logical step is the further development of furnace lines, coking practice, limestone preparation, and adjustment of practice to reduce to a minimum the production of flue dust from the ores which must be used. It appears perfectly practicable that the average plant can reduce flue dust production to less than 125 lbs. per ton of iron. This in fact is being accomplished at three plants at least, and probably more. This corresponds to a total production of about 33 tons of flue dust per day per 500-ton furnace, including dust-catcher, gas cleaner, and unremoved from gas. As to gas-cleaner dusts, about 20,000,000 tons furnace capacity is equipped with secondary cleaners, wet or dry type. This is nearly half the total capacity and probably is more than half of the usual capacity that actually operates on more or less full time. It is believed that 1,000,000 tons of flue dust are lost at these plants every year. These dusts can be recovered for a capital expenditure, per 500-ton plant, of certainly less than five cents per ton of pig-iron capacity, and less than 14 cents per ton pig-iron for plant operation. This would effect a saving of 15 cents per ton of pig-iron, or about $27,500 per year for a 500-ton furnace, over and above replacement charges on equipment cost and labour and material in operation of recovery and preparation plant.

XUM

Correspondence.

[We accept no responsibility for the statements made, or opinions expressed, by our correspondents.]

Pouring Castings without Feeding Heads.

To the Editor of The Foundry Trade Journal.

Dear Sir,—M. Ronceray's rejoinder in your issue of August 11 is interesting, and is likely to be of service to British foundrymen generally, but there is an air of complaint in the article that is not too pleasant to the parties mentioned. We take it, however, that his phrasing implies a tone or meaning that was not really intended.

The writer and his colleagues regard their own and M. Ronceray's experiments as experiments only, and in no way conclusive or as resulting in any definitely proved fact, yet M. Ronceray, finding Mr. Hall's opinion diametrically opposed to his own on one point, takes him most severely to task. We think it should be made clear at this stage that we, in common with M. Ronceray, are dealing with experiments only, and that these experiments are yet in their initial stages.

Dealing paragraph by paragraph with the article of August 11, some comment on the suggested errors of translation mentioned by M. Ronceray is permissible. In the previous article we wrote: "It is rather difficult to make everything quite clear when dealing with a foreign language on technical questions," and went on to foreshadow the possibility of losing the technical sense in the process of translating French into English, therefore a certain amount of licence was taken in the words used, but wherever possible the word most closely approximating to the original was selected. Exact equivalents are, however, often very hard to find. The word "masselotte" is a good illustration of my point. According to the "Dictionnaire Technologique" published by Charles Beranger, of Paris, this word in English may mean "runner," "feeding head," "sullage piece," or "dead head"; by implication also "riser." Of these synonyms (?) the Editor of The Foundry Trade Journal selected "feeding head" as the most comprehensive, and added a footnote to that effect. Without wishing to be pedantic, we might mention that the German equivalents of "masselotte" are still more puzzling, *e.g.*, "der Auguss," "der Gusszapfen," "der Giesskopf," "verlorene Kopf," "der Uberguss." It will thus be seen that "masselotte" is a pretty comprehensive term

We agree that "check" expresses "chape" better than "cope" in its context, and certainly clears the air. However, "chape" is literally "cope" in many technical senses.

The word "galler" was a difficulty, and proved to be unfamiliar to any of the available authorities, including a few French and Belgian technichists. "Scab" is undoubtedly correct.

"Narrow jet" seems to us to be a sufficiently correct rendering, as the reader has a diagram to which to refer.

For "hot casting" we apologise. This is, without doubt, a *lapsus calami*, which would have been detected had there been more time for re-reading the translation. The same must apply to "events." "Métal épuré," following the analogy of distillery and kindred trades, should mean refined metal, but when water is in question, "épurer" means "to filter." After all, filtration is, in a sense, the first step towards refining. Thus we have a distinction without much difference.

Having cleared the air of a few technical translation difficulties, we will now endeavour to deal with other items of interest, bearing in mind M. Ronceray's technical meanings rather than our own; but, of course, we could not continue the discussion without knowing the full intention of the words actually used.

The experiments carried out by us cannot be said to confirm M. Ronceray's views as he states, except to a small extent, and certainly not to a great extent. We cannot see that it is plainly stated that the methods adopted did not apply to massive castings, and, without reference to the exact page and column, we can only assume that M. Ronceray is referring to page 6, column 1, where he says "except with castings showing at the same time a thick and a thin part—with blocks and pipes we have not obtained the same satisfaction."

Our Fig. 1 can be termed a massive casting, but it has both thick and thin parts, *i.e.*, parts of varying thicknesses, and we did not put this forward "for" or "against" M. Ronceray's method. We merely asked a question with reference to this casting, *vide* page 35, col. 2, of our article—"Does M. Ronceray maintain," etc.—and more especially to point out the advantage of the quick pour as against the suggested slow pour method. We find ourselves practically in agreement with M. Ronceray regarding Figs. 3, 4 and 5 on his methods, but we suggest that with the vent wire, or coal dust mixed with the sand, his methods might be successful even with this type of casting, and since our previous article this casting has been made in our foundry without a riser, successfully, it being cast horizontally instead of vertically.

M. Ronceray misses the mark when he says Fig. 2 is yet another confirmation of his point; it is just the contrary. M. Ronceray, in his article of July 7, page 5, column 1, distinctly states the thick part of the shell should be at the top; Figs. 4, 5 and 6 also bear out his statement that most castings are best poured thick side up. The difficulties were not met by us during the war, as M. Ronceray suggests. We quoted facts known to us of large foundries having failures through casting thick side up; no fault could be attached to the core; the one great fault was spongy metal in the thick part of the shell. Our method, which was adopted by many foundries, viz., casting the shell heavy-end down, Fig. 2, col. 1, page 35, July 14, eliminated all signs of porosity or sponginess in the metal. No doubt had M. Leonard (referred to in M. Ronceray's article of July 7, page 4, bottom of col. 1) adopted this principle of casting he would have had the same result as we obtained. The mere fact of the core vent being uppermost gives the gas every chance of escaping.

Re Fig. 6. We contend that this casting does comply in every respect with the conditions suggested by M. Ronceray. Referring again to page 6, col. 1, of July 7 article, viz., "a thick and a thin part"; and therefore, irrespective of whether the casting is badly designed or not, we selected it for experiment, and made special reference to badly-designed castings on page 35, col. 2, July 14. Who is to say whether it is a good or bad design? We are not discussing designs. This is a casting which must be made as shown. We cannot tell the machine makers that they must alter the design of their machine or its parts because it is not suitable to M. Ronceray's methods of casting. We seem to have hit on here a nasty example for experiment, that is all. Meanwhile, we would say we tried to alter this design, but it cannot be permitted. Owing to the large variation in the thicknesses, we selected it to comply with the conditions—and, in addition, it is not a "massive" casting. We contend it proves M. Ronceray's methods as questionable in castings of this nature. Since reading the article of August 11, we have tested the casting, as suggested by M. Ronceray, and cannot detect any difference as he suggests might exist. Anyway, no difference which would give any practical advantage one way or the other, and, therefore, further discussion is really necessary relating to this one especially. We may say we have made these in quantities, and they are put to a severe strain, and so far no breakages have occurred.

Dealing with col. 2, page 108, August 11, we are not clear as to what M. Ronceray is alluding when he states "favourable conditions." We do admit, and have proved, that with M. Ronceray's method certain castings, with limitations, under favourable conditions are a success, others, still retaining M. Ronceray's conditions, are absolute failures; but at the same time we do contend that it is possible to find out what the limitations must be, and what is the governing factor in the design which would make the castings with his method a success.

Will M. Ronceray please say whether his methods are applicable to the single casting of certain designs, or does he intend to imply that it is for casting in quantities? Assuming that it is in quantities, the saving might pay for the experiments with the first few, but certainly no saving

would be made in a general shop by adopting his methods for castings of one or two, with the risk of having wasters. Really, the only saving from M. Ronceray's methods is the saving of the wastage of metal in the risers, which is a fraction quite out of consideration if dealing with a few castings off one pattern. What we mean by this is that our men in the general shop will, perhaps, make 50 castings right off, each from a different pattern.

We note that in M. Ronceray's article all the figures and the designs shown are moulding machine parts, on which, no doubt, he has been practising for some years, and which, of course, lend themselves very favourably to experiments. On the other hand, every one of ours, from start to finish, are practically castings which are extraordinary, or which we might reasonably term unique, and which would not lend themselves to repetition, with the exception of the shell, Fig. 2, and the plate, Fig. 3, which M. Ronceray says are not applicable to his methods. Fig. 6 might be a repetition casting, but usually there are slight alterations here and there which prevent them being really termed "repetition castings." We agree with M. Ronceray that the most useful point to find out is the reason for success, and, we would add, also the reason for failures. What would be interesting would be if M. Ronceray could give us the result of his experiments on any castings similar to those depicted in our figures.

We note with great pleasure that the well-known firm of W. & T. Avery, Limited, Birmingham, are also interested in these experiments, but here again the photographs, viz., Fig. 1, appear to me also to be part of a moulding machine. We should like Messrs. Avery to give the result of the method on some of their other castings, they being practical engineers who make repetition castings, and should be in a position to experiment very favourably; but we doubt, from what we know of their work, whether they have anything but a small percentage which could be successfully made by M. Ronceray's methods. We take it that these castings as shown were made by Messrs. Avery, and are not merely photographs of what they saw at M. Ronceray's foundry.

What is the step farther than the experimental stage?

We are hoping at an early date to go over to M. Ronceray's foundry with the object of spending some days on these experiments, and we are hoping we shall be able to take Mr. Hall with us, who is a practical and experienced man, and would be able to deal with the matter from a practical moulder's point of view, at the same time observing all the technicalities which would be necessary.

M. Ronceray must bear in mind that once we start experimenting, if there is any likelihood of saving or improvement which might lead to success, we do not object to any one method merely because we go down on the first one or two trials.

With regard to the formula which Mr. Ronceray gives, this cannot be used from a practical point of view. It would be very difficult indeed for anyone to determine, without a great deal of expense and time, as to whether certain castings comply with this formula or not.

Like M. Ronceray, the metal which we used was very hot; in fact, was as hot as we dared use it without boiling.

We do not think it can be suggested that either the writer or Mr. Hall are supposing that M. Ronceray's opinion is that "risers" must never be used in the future, nor that all work can be made successfully without, but we are of the opinion that M. Ronceray's first article was written with the object of showing that castings generally (this word "generally" must be taken with a certain amount of reservation) could be made by his methods.

We are not in a position to say what the cases are, which previously have been impossible, but which have now been made possible by M. Ronceray's methods, and it would be interesting if he would give the photographs side by side showing why such castings would be impossible in the one case and were a success in the other.

We would say that the whole discussion really arose from the fact that a foundryman who saw the casting shown in Fig. 1, page 35, col. 1, of my article, July 14, suggested that this casting could be made without the large risers, and, in fact, without any risers at all, if M. Ronceray's methods were adopted. By a strange coincidence it happened around the same time that M. Ronceray's article appeared in "La Fonderie Moderne," therefore it will be readily observed why we are so interested.

It is with the object that something might be gained that we set to work to find out the why and the wherefore, and between us we might determine the laws that govern the result.

M. Ronceray need not express surprise at my remarks *re* filtration of metal. The inner-expressed meaning of my remarks applies to MM. Lelong & Mairey's principle, because it would seem that we are not talking about the same practical term. It is not my intention to suggest that skimming is not necessary, but we are contending that skimming can be obtained by other means just as effectively without incurring the expense of specially made skimming gates. We do assert that they are more costly than ordinary hand-cut gates, but with correct methods adopted, which we term "plugged" runners, the metal is filtered just as effectively as the bottom pouring ladle for steel. This, as an ordinary method, does prevent slag from going into the casting. The 3-in. or 5-in. thick riser does not collect slag, and it has been proved in Fig. 1 that these were used successfully for feeding purposes only.

Before concluding, I must make some reference to Mr. Hall's letter, which will be further to the point, viz., that I consider it best to rely on Mr. Hall's separate comments. It must be understood, however, that the experiments and expressions are collateral, and therefore we would like to confirm that with what he states we are in agreement.—Yours, etc.,

HAROLD MEASURES.

Croydon Foundry,
September 1.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I very much regret M. Ronceray should take exception to my letter of July 21 simply because his ideas and practice are different from mine. To arrive at the solution of a problem we may all start at different points, our opinions may differ as to the point at which we start to reach the object in view, but it does not matter; and M. Ronceray stands alone when he suggests I started these experiments with preconceived ideas. My ideas and knowledge have been gained during the 32 years spent in the foundry.

I hold no brief for makers of jolt-ram machines, and during my experience and practice I have used hand ramming, jolt rams, compressed air squeezers, and hydraulic machines, and I still maintain the jolt ram is the nearest approach to perfect ramming that I have seen, and I have never had a vent wire used on anything moulded on any kind of machine under my supervision.

Many foundrymen are of the same opinion as myself. Where one machine will accomplish a job successfully, another will prove a failure, and many ways employed for machine moulding will not apply when a pattern is hand moulded.

A friendly discussion is seed for knowledge, but if one side insists that only they are right the sooner the discussion is dropped, the better.—Yours, etc.,

GEORGE HALL.

Croydon Foundry,
September 1.

IN RESPONSE to a request from the Chemical and Dyestuff Traders' Association for a written ruling to remove the uncertainty that prevails respecting the goods subject to duty on October 1, the following reply has been received from the Commissioners of Customs and Excise:—(1) That duty under Part 1 of the Safeguarding of Industries Act, 1921, key industry duty will be chargeable on all goods of the kinds liable thereto which have not been reported by the importing vessel and entered with the Customs by the close of the working day on September 30. Goods which have been so reported and entered will not be liable to the duty, even though they may not have been cleared out of Customs charge prior to October 1. (2) Goods liable to key industry duty and not to any other Customs duty will not be admissible to bonded warehouses, and the duty must be paid on the first importation of such goods.'

Trade Talk.

The imports of foreign ore at the Workington Dock last week amounted to about 2,600 tons.

Barimar, Limited, announce the opening of a branch factory at 134, West George Lane, Glasgow.

The Spearling Boiler Company, Limited, have removed from 11, Queen Victoria Street, London, E.C.4, to 20, Kingsway, London, W.C.2.

Full time has been restored in the Royal Dockyards at Portsmouth, but the discharge of 50 men weekly will continue for the present.

The Electrolytic Zinc Company of Australasia has completed a contract with the Board of Trade for the purchase of 750,000 tons of concentrates.

An outbreak of fire has occurred in the premises of Messrs. Alexander Waddell & Sons, engineers and brass founders, Corstorphine, Edinburgh, considerable damage being done.

A second furnace was lighted at the Ulverston Ironworks on September 23. There are now three furnaces blowing in the Furness area—two at Ulverston and one at Barrow

The boring operations in the neighbourhood of Dearham have been completed, and the plant is being removed into the Millom district, where, it is stated, boring for iron ore is likely to be commenced shortly.

Another furnace has been blown in at the United Steel Companies' works at Moss Bay. This brings the total in blast in Cumberland to four—one each at Cleator Moor and Millom, and two at Moss Bay

By an arbitrator's award in connection with the wages of Welsh engineers and founders, skilled men are to lose immediately 4s. weekly and a further 3s. from November 1. The wages of other workers are reduced in like proportion.

Sir Charles Bright, Mr. A. H. Seabrook, Mr. A. J. Stubbs, and Lieut.-Colonel H. W. Woodall have established themselves in business under the style of Sir Charles Bright & Partners, consulting engineers, 146, Bishopsgate, London, E.C.2.

The Edison Swan Electric Company, Limited, supplied at the request of Capt. Williams, biologist to the Shackleton-Rowett Expedition, a 100 c.p. "Pointolite" outfit, which will be used principally for critical examination and microscopic work.

Licences under the Non-Ferrous Metal Industry Act 1918, have been granted to: Adamson's (Sheffield), Limited, 18, York Street, Sheffield; Moorhouse & Hudson, 87, Hillhouse Lane, Huddersfield; and J. R. Scholes, 14, Argyll Chambers, 67, Hanging Ditch, Manchester.

To a meeting of railway engineers, held in Glasgow, Mr. N. M. Clougher delivered a lecture on mechanical railway construction and maintenance, accompanied by a demonstration on the cinema screen, showing practical work on the French and English railway systems.

The Cumberland iron-ore miners recently accepted a reduction in wages, and it was expected the Furness miners would also agree to a temporary cut of 10 per cent. in wages on a promise of a resumption of work. By a ballot, however, this offer has been declined by 509 to 310 votes.

The Disposal and Liquidation Commission announces that Sir Howard Frank has signed a contract for the sale to the British Metal Corporation, Limited, of the whole of the brass scrap in Great Britain belonging to the Government. The purchase price is expected to work out at approximately £4,000,000.

Messrs. J. C. Bishop and O. Coyle, joint secretaries of the Scottish Manufactured Iron Trade Conciliation and Arbitration Board, have been informed by the accountant that the average net selling price of Scottish manufactured iron for July and August was £17 0s. 1.39d. per ton. This means a decrease in the wages of the workmen of 25 per cent. on basis rates.

The Sunderland Town Council have decided to accept an English firm's tender for tram rails, although others were offered at a cheaper price by a foreign firm. Not satisfied with the decision, the Tramways Committee are once more to recommend that the foreign tender be accepted. For certain new tramway standards the tender of John Spencer, Limited, of Wednesbury, has been accepted.

After January 31 next new rules and regulations will govern the carriage of goods by sea, if, as seems probable, the general body of traders accepts an agreement reached at The Hague by the Maritime Law Committee of the International Law Association. Known as The Hague Rules of 1921 the new code has already been agreed to by the leading Liverpool underwriters, and its adoption has been recommended to the Manchester Chamber of Commerce and the Manchester Association of Importers and Exporters by the Joint Bill of Lading Committee of those bodies.

The joint auditors' report on the South Wales and Monmouthshire Iron and Steel Workers' sliding scale has now been received for the three months ending August 31, 1921, and shows a reduction in the sliding scale of 10S per cent. The scale at present stands at 172½ per cent. above the standard, so that as and from October 1 next it will stand at 64½ per cent. above the standard.

Guaranteed financial support for five years, the Cleveland Technical Institute, Middlesbrough, was opened on September 22 by Sir Charles Parsons. The building provides spacious accommodation for the pursuit of scientific knowledge—lecture halls, library, and other facilities for study and intercourse. So far as Teesside is concerned, Sir Hugh Bell, who presided, expressed the opinion that the Institute educationally made it more necessary that they should have a technical college, and he remarked that it was the clash of minds that produced the spark of knowledge.

The agency arrangement hitherto existing between Thos. Firth & Sons, Limited, Sheffield, and Wheelock, Lovejoy & Company, of New York, has been terminated, and Thos. Firth & Sons, Limited, have appointed Mr. H. G. Hides as their general sales manager for the United States. Mr. Hides for the past 20 years has represented Wm. Jessop & Sons, Limited. The stock of Firth-Sheffield steel sheets will be carried in the warehouse of the Firth-Sterling Steel Company, 312, Hudson Street, New York, an associate concern. Both Thos. Firth & Sons and the Firth-Sterling Steel Company are opening offices in Hartford, Conn., where Mr. Hides will have his headquarters.

The Vulcan Foundry, Limited, have secured orders for nine locomotives for the Oudh and Rohilkhand Railway, and five metre-gauge engines for the Mysore State Railways. The Hunslet Engine Company, Limited, of Leeds, are to build three tank locomotives for the Burma Railways. Kitson & Company, Limited, are building seven locomotives for the Palestine railways and one engine for the Ceylon Government Railways, whilst the North British Locomotive Company, Limited, in addition to orders in hand for forty-five engines for the New Zealand Government Railways, are delivering seven engines for the Gold Coast Railways, and six 4-6-4 type tank engines to the Glasgow and South-Western Railway.

A serious situation has arisen in the engineering and shipbuilding trades owing to the breakdown of negotiations between the employers and men's representatives on the question of the withdrawal of the Ministry of Munitions' war bonus of 12½ per cent. on total earnings for time workers and 7½ per cent. on piece rates. The Engineering Employers' Federation and the Shipbuilding Employers' Federation have held separate and protracted meetings with the trade unions concerned, and in the absence of an agreement the employers' notices to discontinue payment of the war bonus will, it is understood, take effect as from October 12. The following official announcement has been issued by the Ministry of Labour:—Following the decision of the conference of delegates of the Engineering and Shipbuilding Trades Federation and the Amalgamated Engineering Union, the negotiating committee of the unions requested an interview with Dr. Macnamara, Minister of Labour. At this meeting the committee reported to Dr. Macnamara the facts concerning the negotiations with the Employers' Federations, and requested that he might take the matter into consideration in accordance with Section 2 (1) of the Industrial Courts Act.

CONSTRUCTION OF A PIPE LINE IN TRANSYLVANIA.—In connection with the laying of a pipe line, 26 kilometres in length, for the supply of natural gas to the town of Targul-Mures, in Transylvania, His Majesty's Consul at Cluj (Mr. Charles Goodwin) has obtained from the engineer in charge of the scheme a statement of the material which will be required. This includes 8,000 metres Mannesmann steel pipe; 21,600 metres steel pipes of various diameters; 17,700 metres drilling tubes of various diameters; 15,000 kilogrammes steel for hand tools; 40,000 metres galvanised iron or copper wire; various valves and fittings; spades, shovels, mattocks; also tools for two iron workshops and two mechanical workshops; 500 metres camel hair belting pulleys, etc. Quotations for the supply of this material are desired from United Kingdom firms who would be prepared to grant a long credit of three or more years. The name and address of the engineer to whom inquiries relating to this matter should be addressed, together with full details of the material required, may be obtained by United Kingdom manufacturers and exporters on application to the Department of Overseas Trade (Room 50A), 35, Old Queen Street, Westminster, S.W.1.

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IRON AND STEEL MARKETS.

Pig-iron.

Any improvement expected in market conditions have so far failed to materialise, the demand for pig-iron everywhere remaining lifeless, due in a great measure to slackness in the foundry industry, buying for which is reduced to almost nominal quantities. The chief factor in the present impasse is, of course, the question of price. With quotations reduced, the demand would certainly expand, but no further price cutting is reported as yet.

In the Cleveland district the bulk of the furnaces are still idle; coke is still too dear for the ironmasters, and the latter declare that there is no demand for their iron, even if the furnaces were working. On Tees-side, there seems to be an impression that some of the lower qualities might be bought below the quoted figures, but there is no report of any such transaction, and the makers seem to be adhering to the official price list, viz., 120s for No. 3 Cleveland G.M.B.; 119s. for No. 4 foundry; 117s. 6d for No. 4 forge and mottled; 115s. for white iron. At Manchester, the prices for foundry iron do not alter much, though now that there is more Cleveland iron at £6 on trucks, and some Northamptonshire iron at £5 15s., the sellers of Derbyshire iron are perhaps a little more inclined to accept lower prices. The consumer, however, has still to pay £7 to £7 5s. per ton for ordinary No. 3, and apparently the practice of the foundries is now to buy in truck loads, and keep the stock in the yard at as low a figure as possible.

There is only a limited market at home for East Coast hematite, and still less demand from abroad. Makers are keen to do business, but have not cut prices below 130s. for mixed numbers, and 132s. 6d. per ton for No. 1 quality. In Cumberland and North Lancashire slightly more activity in the smelting industry is observable, additional furnaces being put into operation, chiefly for the production of low phosphorus iron, which is stated to be in growing request. Buying is, however, chiefly confined to small parcels for immediate requirements. The price has been reduced to £7 5s., delivered Sheffield.

Finished Iron.

Progress in expansion of the finished iron section of the industry continues at an extremely slow pace, and although fewer mills and forges are entirely idle the position remains by no means encouraging. Inquiries, though in better volume in some branches, do not appear to materialise in any increase in business, and though the recent decision of the Lancashire bar makers to reduce the price of crown qualitites by £2 per ton should have marked a step in the direction of an all-round revision of quotations, the movement has not been unanimously followed, South Staffordshire producers having so far declined to readjust their values. It is, however, regarded as possible that this week's quarterly meeting at Birmingham may witness some developments in this connection, although, so far, local makers of unmarked bars have held firmly to the opinion that a reduction of their list prices at the present juncture would fail to stimulate business to any appreciable extent. Similar views on the subject are held by Yorkshire bar mill owners, and in both that and the South Staffordshire area prices remain at £16, the old quotation.

Steel.

Conditions in the principal centres of the steel industry have undergone little improvement since last reported, most of the branches continuing either idle altogether, or only partially employed, while the majority of producers are simply holding on in the hope of an early change for the better. The open-hearth branch continues very quiet, only a small proportion of the Sheffield furnaces being employed, and while makers keep easing their quotations to obtain business, the comparative cheapness of Continental steel is a considerable handicap in open competition. It is, however, not quite so easy now to obtain supplies of material from foreign sources as has hitherto been the case, deliveries from Belgium, France and Germany being considerably in arrears, while America for the time being has practically suspended operations in steel exports. Nominally, home quotations stand at the old figures, but the tendency is downward. Soft basic billets are down to about £7 10s., a fairly substantial drop, though still somewhat higher than German material, the quality of which is, however, inferior. A fair lot of business is passing in bright steel bars, the price of which is £20. Quieter conditions obtain in a number of branches of the Sheffield hand tool trade, orders for saws, and edge and farm tools having steadily declined for several months past. Twist drill and hack-saw plants are generally on short time, as Continental competition in these important lines is exceptionally keen, especially as regards the small drills.

We regret that the prices of finished steel were incorrectly reduced by £2 per ton in our issue of September 22, in consequence of the receipt by wire from a usually well-informed source of information to that effect.

Tin plates.

Business in the tinplate trade, after a period of unprecedented depression, shows at last signs of reviving activity, and though, of course, somewhat slow, is nevertheless encouraging after the stagnation of the past few months. There is a fair inquiry, a moderate amount of business resulting. Prices are being lowered, transactions reported ranging from 20s. to 21s. basis for coke finish, net cash, f.o.b. Wales, in ordinary specifications, delivery over October to December. There is quite a demand for spot lots, which are realising round 22s. basis for cokes. Wasters are wanted in 14 by 20 light substances; these are scarce and command full prices. Full weights are steady, and in moderate request at 20s. for CW. 14 by 20; 39s. for CW. 28 by 20, and 16s. for CW. 14 by 18¾. CW. 20 by 10 are easy at 20s.; all net, f.o.t. at works. Terneplates show but little improvement in demand, 22s. is quoted, net, f.o.b., without attracting buyers to any extent.

Metals.

Copper.—The position in the standard copper market has undergone little change of late, and in the absence of buying movements on general consumptive account business has only been moderate in volume. This week's markets, however, opened with more encouraging reports from America, and the general tendency was distinctly firmer. October was sold at £68 15s. to £68 12s. 6d., closing at the first-named figure; November £69, and December £69 5s. Closing prices:—Cash: Wednesday, £68 7s. 6d.; Thursday, £68 5s.; Friday, £68 7s. 6d.; Monday, £68 7s. 6d.; Tuesday, £68 12s. 6d. Three Months: Wednesday, £69 5s. Thursday, £69 5s.; Friday, £69 7s. 6d.; Monday, £69 7s. 6d.: Tuesday, £69 10s.

Tin.—The chief feature of interest in the tin market has been the gradual return of confidence, expressed by a better volume of buying orders, with a consequent improvement in values. The week opened with Eastern advices reporting buyers at £158, c.i.f., and under an increased consumptive demand values stiffened with pronounced interest in the October position, forward deliveries for this month realising up to £158 5s. November was done at £158 to £159, December £159, and Straits cash fit £158 to £158 10s. English ingots advanced 15s. to £155 5s. to £156 5s. Closing prices:—Cash: Wednesday, £156 10s.; Thursday, £156 5s.; Friday, £156 10s.; Monday, £157 5s.; Tuesday, £156 10s. Three Months: Wednesday, £158 10s.; Thursday, £158 10s.; Friday, £158 7s. 6d.; Monday, £159 10s.; Tuesday, £158 10s.

Spelter.—The undertone in this market continues good, but offers from the Continent are still disappointing. Demand for the galvanising trade shows little activity, but general buying on the part of consumers is more encouraging than of late. Closing prices:—Wednesday, £26 10s.; Thursday, £26 7s. 6d.; Friday, £26 7s. 6d.; Monday, £26 12s. 6d.; Tuesday, £26 10s.

Lead. — The week's markets for soft foreign lead opened with a fairly active demand, and a substantial turnover in the metal resulted in a small increase in selling values. October was done at £23 2s. 6d., November £23 2s. 6d., and December £23 2s. 6d. English closing prices:—Wednesday, £24 5s.; Thursday, £24 5s.; Friday, £24 5s.; Monday, £24 5s.; Tuesday, £24 5s.

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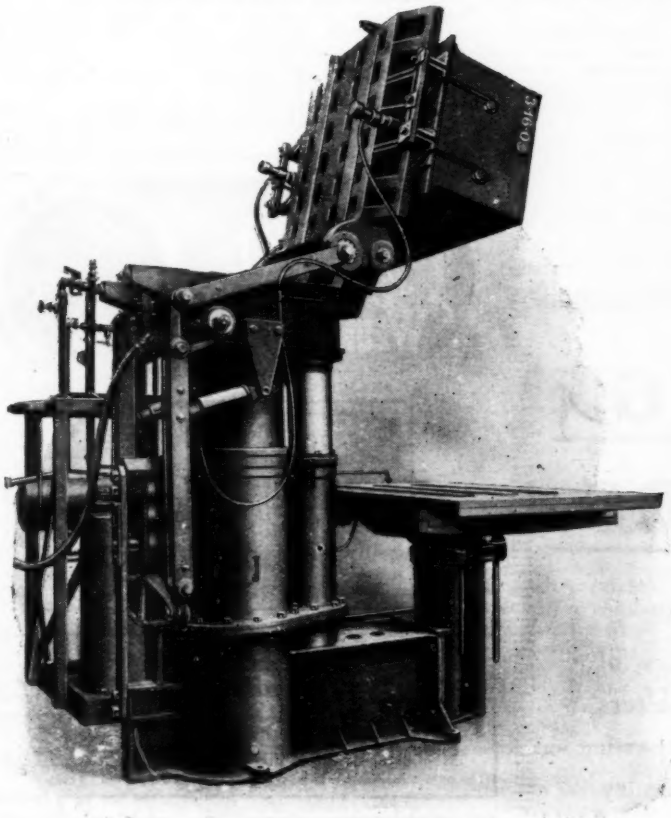

Mould having been rammed, box and pattern in act of being rolled over on to levelling table on other side of machine.

Jar rams the box in less than one minute.

Rolls the mould over, draws and raps the pattern.

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Company News.

H. H. Vivian & Company, Limited. — No interim ordinary dividend.

Vulcan Foundry, Limited.—Further dividend, 10 per cent. actual, making 15 per cent. for year.

Bruce Peebles & Company, Limited.—Cumulative participating preference dividend, 7½ per cent. per annum, less tax.

Dobson & Barlow, Limited.—Ordinary dividend 10 per cent., making 17½ per cent. for year; reserve, £35,000; carried forward, £20,878.

Artic Fuse & Electrical Manufacturing Company, Limited.—Capital £5,000 in 4,700 ordinary and 100 deferred shares of £1, and 4,000 founders of 1s.

Holtzapffel & Company, Limited.—Capital £12,000 in £1 shares, to carry on the business of engineers. Registered office: Bassishaw House, Basinghall Street, E.C.

Jesmond Electrical & General Engineering Company, Limited.—Capital £1,000. Directors: T. Sloan and Mrs. C. M. Sloan. Registered office: Newcastle-on-Tyne.

Newcastle Electric Supply Company, Limited.—Profit for six months ended June 30 last not such as to justify payment of interim dividend on ordinary or preference shares.

J. Stone & Company, Limited.—Profit, £101,889; brought in, £125,774; total, £227,663; ordinary dividend, 7½ per cent. per annum; carry forward, £152,633.

British Metal Pressings (1921), Limited.—Capital £15,000 in £1 shares, to acquire the business of W. West, Nile Street, Birmingham, trading as the British Metal Pressings Company. Registered office: Nile Street, Birmingham.

Argentine Iron & Steel Company (Pedro Vasena e Hijos), Limited.—Net profit, £106,389; heavy stocks on hand and great fall in steel prices necessitates transferring whole to reserve for contingencies; £210,000 appropriated and applied in writing down value of stocks.

Eglinton Magnesite Brick Company, Limited.—Capital £50,000 in £1 shares, to adopt an agreement with J. le Boutillier. First directors: C. Brenner, W. Donald, A. A. Eckhout, J. le Boutillier, and Dr. Ludwig Pawlaczky. Registered office: Colonial House, 17, Tooley Street, S.E.1.

Gazette.

Trading as the B.P. Engineering Company, Messrs. J. H. Badger and W. Parkinson, Garden Street, Padiham, engineers, have dissolved partnership.

Concord Engineers, Limited.—It was resolved September 16:—That the company be wound up voluntarily. Mr. J. Peacock, Glasgow, C.A., was appointed liquidator.

Marseel Engineering Company, Limited.—It was resolved September 17:—That the company be wound up voluntarily. Mr. E. F. Peirson, 17, Hertford Street, Coventry, C.A., was appointed liquidator.

Messrs. W. Barnett, F. Saunders, and P. J. Thompson, trading as the B.S.T. Electric Fittings Company, Dixon's Green, Dudley, engineers, have dissolved partnership. Debts by Mr. F. Saunders, of Dudley Road, Tividale, Tipton.

Applications for Patents.

The names of communicators are printed in italic type. A new number will be given when the Complete Specification is accepted.

Anderson, A. C., and Vickers, Limited. Governing and protection of hydraulic turbines, etc. 24,569. September 15.

Anderson, H. N. Apparatus for rolling teeth on gears. 24,533. September 15. (United States, September 17, 1920.)

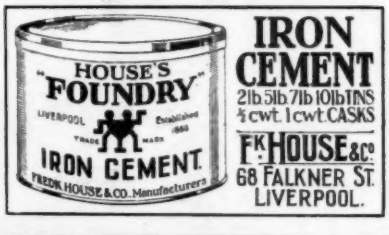
Austin, F. C. Portable electrically-driven combination tools. 24,442. September 14.

Automatic Temperature Control Company. Electrically-operated automatic valve regulators. 24,340. September 13.

Barber, G. A. and G. A. H., and Sellen, W. A. and W. J. Iron and steel bending and link-making machinery. 24,427. September 14.

Bateman, L. H. Driving and reversing mechanism. 24,559 September 15

Beacham, T. E., and Boyd, A. J. Gauges, etc., for registering liquid levels. 24,705. September 17.



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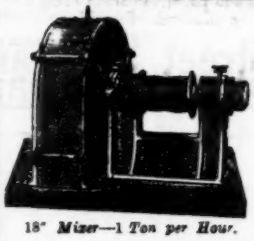

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